```
stars by prs for s/w 2b
6077/
/stars 1 · 3/13/62, prs.
          decimal
          define
mark X, Y
          repeat 8, Y=Y+Y
          8192-X
                          Y
          terminate
1j,
          mark 1537, 371
                                 /87 Taur, Aldebaran
          mark 1762, -189
                                 /19 Orio, Rigel
          mark 1990, 168
                                  /58 Orio, Betelgeuze
          mark 2280, -377
                                  /9 CMaj, Sirius
          mark 2583, 125
mark 3431, 283
mark 4551, -242
                                 /10 CMin, Procyon
/32 Leon, Regulus
/67 Virg, Spica
          mark 48\overline{42}, 448
                                 /16 Boot, Arcturus
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          mark 6747, 196
                                 /53 Aqil, Altair
         mark 1819, 143
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                                 /24 Orio, Bellatrix
          mark \1884, -29
                                 /46 Orio
         mark 1910, -46
                                 /50 Orio
                                 /53 Orio
/ 2 CMaj
         mark 1951, -221
mark 2152, -407
         mark 2230, 375
                                 /24 Gemi
         mark 3201, -187
                                 /30 Hyda, Alphard
         mark 4005, 344
mark 5975, 288
                                 /94 Leon, Denebola
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                                 /55 Ophi
Зj,
                  46, 333
         mark
                                 /88 Pegs, Algenib
                 362, -244
490, 338
         mark
                                 /31 Ceti
         mark
                                 /99 Pisc
                 566, -375 621, 462
         mark
                                 /52 Ceti
         mark
                                 / 6 Arie
                                 /68 Ceti, Mira
         mark 764, -78
                900, 64
         mark
                                 /86 Ceti
         mark 1007, 84
                                 /92 Ceti
         mark 1243, -230
                                 /23 Erid
         mark 1328, -314
                                 /34 Erid
         mark 1495, 432
mark 1496, 356
                                 /74 Taur
                                 /78 Taur
         mark 1618, 154
                                 / 1 Orio
/ 8 Orio
         mark 1644, 52
         mark 1723, -119
                                 /67 Erid
         mark 1755,
mark 1779,
mark 1817,
                      -371
                                / 5 Leps
                      -158
                                /20 Orio
                       -57
                                 /28 Orio
         mark 1843,
                       -474
                                 / 9 Leps
                      -8
         mark 1860,
                                 /34 Orio
         mark 1868,
                      -407
                                /11 Leps
         mark 1875, 225
                                 /39 Orio
         mark 1880,
                                 /44 Orio
                       -136
         mark 1887, 480
mark 1948, -338
                      48õ
                                /123 Taur
/14 Leps
         mark 2274, 296
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                             / 3 CMin
 mark 2513, 193
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                             /16 Hyda
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mark 3668, -357
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                            /30 Leon /41 Leon, Algieba
                            /nu Hyda
                            /68 Leon
 mark 3806, 364
                            /10 Leon
 mark 4124, -502
                            / 2 Corv
/ 4 Corv
/ 7 Corv
 mark 4157, -387
 mark 4236, -363
 mark 4304, -21
                            /29 Virg
mark 4384, 90
mark 4421, 262
                            /43 Virg
                            /47 Virg
 mark 4606, -2
                            /79 Virg
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mark 5186, -205
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                            /8 Boot
/9 Libr
/27 Libr
                            /24 Serp
mark 5357, 358
                            /28 Serp
mark 5373, -71
mark 5430, -508
mark 5459, -445
                            /32 Serp
/ 7 Scor
/ 8 Scor
 mark 5513, -78
                            / 1 Ophi
                            / 2 Ophi
/27 Herc
/13 Ophi
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mark 5609, 494
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                            /35 Ophi
/64 Herc
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mark 5984, -349 mark 6047, 63
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/62 Ophi
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                            /64 Ophi
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mark 6439, -483
mark 6490, 312
                            /58 Serp
/37 Sgtr
                            /17 Aqil
mark 6491, -115
                            /16 Aqil
mark 6507, -482
                            /41 Sgtr
                          /30 Aqil
/50 Aqil
mark 6602, 66
mark 6721, 236
mark 6794, 437
                          /12 Sgte
mark 6862, -25
                           /65 Aqil
mark 6914, -344
                           / 9 Capr
/ 6 Dlph
mark 7014, 324
                           /22 Agar
mark 7318, -137
mark 7391, 214
                           / 8 Pegs
                           /49 Capr
mark 7404, -377 mark 7513, -18
                           /34 Agar
mark 7539, 130 mark 7644, -12
                           /26 Pegs
                           /55 Agar
                           /42 Pegs
/76 Agar
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                      /33 Pisc
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        54, 447
                      /89 Pegs
        54, -443
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                      / 7 Ceti
                      / 8 Ceti
        82, -214
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       223, -254
                      /17 Ceti
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       248, 160
mark
                      /63 Pisc
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       273, -38
                      /20 Ceti
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       329, 167
                     /71 Pisc
/84 Pisc
       376, 467
450, -198
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                      /45 Ceti
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mark
                      /106 Pisc
       570, 197
mark
                      /110 Pisc
       595, -255
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                     /53 Ceti
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mark
            -247
                     /55 Ceti
                     /5 Arie
       615, 428
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       617, 61
                     /14 Pisc
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       656, -491
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                      /65 Ceti
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                     /72 Ceti
/73 Ceti
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838, -357
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       878, -2
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       907, -340
                     /89 Ceti
       908, 221
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                     /87 Ceti
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                     / 1 Erid
       947, -487
                     / 2 Erid
mark
                     / 3 Erid
       976, -212
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mark
       992, 194
                     /91 Ceti
mark 1058, 440
                     /57 Arie
mark 1076, 470
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                     /13 Erid
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                      /73 Taur
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                      /77 Taur
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                      /86 Taur
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/54 Erid
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            -452
                     /57 Erid
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            -78
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            199
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                     / 3 Orio
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                     /61 Erid
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mark 1680, -289
                     /64 Erid
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                     /65 Erid
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                     /102 Taur
mark 1700, 347
                     /11 Orio
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                     /69 Erid
                     / 3 Leps
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                     . + Leps
/ 6 Leps
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mark 1792, -302
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mark 1801, -11
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mark 1909, 375
                     /126 Taur
mark 1936, -511
                     /13 Leps
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                     /16 Leps
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                     / 3 Mono
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                     /15 CMaj
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mark 2379, 471
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mark 2428, -8
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mark 2491, -429
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mark 2519, 208
                     / 6 CMin
mark 2527, 278
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mark 2597, -212
mark 2704, -412
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mark 2709, -25
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mark 2757, -431
mark 2768, -288
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                      /17 Canc
mark 2794, 216
mark 2848, -82
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                      /43 Canc
mark 2944, 497
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                         /74 Leon
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mark 3846, 150
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/78 Leon
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                         /30 Boot
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 mark 5013, 53
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 mark 5045, 444
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mark 5074, -90
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mark 5108, 57
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mark 5283, -221
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/38 Libr
mark 5290, -329
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mark 5357, 175
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mark 5372, 420
mark 5381, 109
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mark 5387, 484
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                      /46 Libr
mark 5394, -374
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mark 5467, -464
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/10 Scor
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mark 5497, -437
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mark 5499, -223
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                      /20 Herc
                      / 4 Ophi
mark 5565, -451
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mark 5582, -415
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mark 5609, 50
mark 5610, -484
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mark 5742, 235
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mark 5763, 217
                      /27 Ophi
mark 5807, 293
                      /60 Herc
mark 5868, -8
                      /41 Ophi
mark 5888, -478
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mark 5889, -290
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mark 5924, -114
mark 5925, 96
mark 5987, -183
                     /49 Ophi
                     /57 Ophi
mark 6006, -292
                      /56 Serp
                      /58 Ophi
mark 6016, -492
mark 6117, -84
                     /57 Serp
/66 Ophi
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mark 6119, 381
                      /93 Herc
mark 6119, 67
                     /67 Ophi
mark 6125, 30
                      /68 Ophi
mark 6146, 57
                     /70 Ophi
mark 6158, 198
                     /71 Ophi
mark 6170, 473
                      /102 Herc
                     /13 Sgtr
mark 6188, -480
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                     /106 Herc
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                        /xi Scut
mark 6254, -469
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mark 6255, 494
mark 6278, -333
                        /109 Herc
                        /ga Scut
mark 6313, -189
                        /al Scut
mark 6379, 465
                        /110 Herc
mark 6382, -110
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                        /be Scut
                        /111 Herc
mark 6436, 93
                        /63 Serp
mark 6457, 340
                        /13 Agil
mark 6465, -134
                        /12 Aqil
                       /39 Sgtr
/ 1 Vulp
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mark 6553, 483
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/38 Aqil
/9 Vulp
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/6 Sgte
/7 Sgte
/8 Sgte
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mark 6766, 187
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                       /60 Agil
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mark 6882, 339
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                       / 6 Capr
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mark 6958, -413
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                       /11 Capr
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/ 4 Dlph
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                       /11 Dlph
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/3 Aqar
/6 Aqar
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                       /22 Capr
mark 7161, -461
mark 7170, -401
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mark 7192, -268
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/ 7 Equl
mark 7199, 222
mark 7223, 219
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mark 7263, -393
mark 7267, 441
                       / 1 Pegs
                       /36 Capr
mark 7299, -506
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                       /39 Capr
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mark 7379, -440
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                       /43 Capr
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                       / 9 Pegs
mark 7499, -60
                       /31 Agar
mark 7513, 104
                       /22 Pegs
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mark 7603, -43
                            /33 Aqar
/43 Aqar
                            /48 Agar
mark 7604, 266
                            /31 Pegs
                           /52 Aqar
/52 Aqar
/57 A ar
/62 Aqar
/66 Aqar
mark 7624, 20
mark 7639, 96
mark 7654, -255
mark 7681, -14
mark 7727, -440
mark 7747, 266
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                            /46 Pegs
                            /71 Agar
mark 7779, -185
                            /73 Agar
                            /50 Pegs
/ 4 Pisc
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                75
                           /55 Pegs
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                           /90 Agar
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mark 7919, 62
mark 7923, -222
                           /91 Aqar
/ 6 Pisc
                           /93 Agar
mark 7952, -470
mark 7969, -482
                            /98 Agar
                           /99 Aqar
/8 Pisc
mark 7975, 16
mark 7981, 133
                           /10 Pisc
mark 7988, 278
                           /70 Pegs
mark 8010, -489
                           /101 Agar
                           /17 Pisc
/104 Agar
mark 8049, 116
mark 8059, -418
mark 8061, 28
                           /18 Pisc
mark 8064, -344
                           /105 Agar
                           /28 Pisc
/30 Pisc
mark 8159, 144
mark 8174, -149
mark 8188, -407
                           / 2 Ceti
```

4q,

start 4

/title punch table

ftp/	0 625151 141211 364545 324545 0 0	0 514600 771000 453000 453200 0 0	004277 224145 274545 010171 065151 0	400000 453200 453100 050300 513600 0 0
	364141 224545 374040 376010 010274 0	413600 453000 403700 603700 020100 0 0	402014 010177 073060 412214 615141 141414 0	020100 010100 300700 224100 454300 141400 0
	0 771014 770214 364141 364151 0 101010 101074	0 224100 027700 413600 215600 0 101000 101000	204040 774040 770214 771111 771111 0 000041 001422	403700 404000 207700 110600 314600 0 221400 410000
	0 774545 774141 770505 771010 010300 030200	0 453200 413600 010100 107700 010300 030200	761111 364141 774545 364151 004177 000060	117600 412200 414100 513000 410000 600000

start ps5

```
spacewar 4.4 5/17/63 ddp . pt 1
 3/
            jmp sbf
                                   / ignore seq. break
            imp allo
            ຢູ່ແກຼ່ ຂ1
                       / use test word for control, not iot 11 co
/ interesting and often changed constants
             usual value (all instructions are enscuted,
/symb loc
            / and may be replaced by jda or jsp)
            law : 41
tno,
                                   / number of tores + 1
tvl, 7, rlt, 10,
                       / torpedo velocity / torpedo reload time
            ser 4s
            law : 20
           law i 140
tlf, 11,
                                  / torpedo life
foo, 12, maa, 13,
                       / fuel supply
           -20000
                       / spaceship angular acceleration
           1.0
sac, 14,
           sar 4s
                       / spaceship acceleration
str, 15,
me1, 15,
                       / star capture radius
           10C
                       / collision "radius"
/ above/2
/ 0 to save space for ddt
           6000
me1,
me2, 17,
           3000
ddd, 20,
           -0
the, 21,
                       / amount of torpedo space warpage
          sar 9s
mhs, 22,
                       / number of hyperspace shots
/ time in hyperspace before breakout
/ time in hyperspace breakout
          law 1 10
hd1, 23,
          law i 100
law i 200
hd2, 24,
hd3, 25,
                                  / time to recharge hyperfield generators
hr1, 26,
          scl 9s
                       / scale on hyperspatial displacement
hr2, 27,
           scl 4s
                       / scale on hyperspatially induced velocity
hur, 30,
ran, 31,
grv, 32,
                       / hyperspatial uncertancy
           40000
                       / random number
           sar 6s
                       / gravitational constant
/ place to build a private control word routine.
  it should leave the control word in the io as follows.
/ high order h bits, rotate cow, rotate ov, (both mean hyperspace)
    fire rocket, and fire torpedo. Low order 4 bits, same for
     other ship. Routine is entered by jsp ovg.
40/
owr,
           jup mg1
                      / normally iot 11 control
           / space
. 20/
```

```
/ routine to flush sequence breakes, if they occur.
                ty:
lio 2
lac 0
sbf,
               ·lsm
                jmp i 1
                define
xincr Y, Y, INS
                lac \underline{Y} INS \overline{s}sn
                dac Y
                lac \frac{\bar{y}}{\bar{s}} INS \bar{s} en
                dac X
                term
                define
yincr X,Y,INS
                \begin{array}{c} \text{lac } \underline{Y} \\ \text{INS } \overline{s} \text{cn} \end{array}
                dac Y
                lac X
                -INS+add+sub ssn
                dac X
                terminate
                define
dispatch
               add (. 3
               dap . 1
                jmp .
                term
                define
dispt A,Y,B
               repeat 6
lio Y
jda heb
                                D=:D+E
                ret db1
               term
               define
scale / ,B,C
                lac A
               sar B
dac C
               term
```

```
define
diff V,S,SF
               add i V
dac i V
net SF
               add i S
dac i S
               term
               define
  random
               lac ran
               rar 1s
xor (355670
add (355670
               dac ran
               term
               define
  ranct S,SS,C
               random
               S
               SS
               sma
               cma
```

dac C terminate

```
varsft
             dzm xys
dac t1
idx xys
idx xys
lac t1
v2,
             ser 2s
             dac <del>t</del>1
             SZZ
             jmp v2+R
             scr 2s
             swap
             terminate
define
             undosft
             dac t1
dio t2
lac xys
             add sft
             dap .+
             lac .
dac .+6
             dac .+6
             xor (10000 dac xyt lac t1
                                       / changescr to scl or scl to scr.
             dio T2
             scr.
             scr.
             terminate
define
             integrate A,B
             cli
             lac i A
             scr 9s
scr 1s
div t1
             hlt
             cma+cli-opr
             xet Xyt
             xet grv dac B
             terminate
sft,
             lac .-1
             scr 7s
             ser 6s
             som 5s
             scr 4s
             sor 3s
             som 2s
             sor is
             sar
             scl 1s
```

define

```
/sine-cosine subroutine of dams associates
/calling sequence= number in 10, jds sin or jdacos.
/argument is between +2 pi, with binary point to right of bit 3.
/answer has binary point to right of bit 0. Time = 2.35-? ms.
/changed for auto-multiply, ddp 1/19/63
               0
COS,
               dap csx
               lac (622'0
               add cos
               dac sin
               1mp .+4
sin.
               0
               dap csx
               lac sin
               spa.
               add (311040
sub (62210
sil,
               sma.
               jmp si2
               add (62210
s13,
               ral 2s
               mul (242763
               dac sin
               mul sin
               dac cos
              mul (756103 add (121312
               mul cos
              edd (532511
              mul cos
               add (144417
              mul sin
              scl 3s
              dac cos
              xor sin
              sma
               jmp csx-1
lac (377777)
               lio sin
              api
              cme.
               jmp csx
              lac cos
csx,
              s:2,
              cms.
              add (62210
              Sme.
               jup 813
              รัสส์ (62210
              ຮຽຄ
              3mp .+3
              sub (52210
imp si3
```

suh (62210

```
/integer square root
/input in ac, binary point to right of bit 17, ida set /answer in ac with binary point between bits 8 and 9
/largest input number = 177777
sqt.
             dap squ
law : 23
             dac sca
             dzm sq2
             lio sit
dzm sit
             isp sqi
sq3,
             ing .
sqx,
             lac sc2
             sal 1s
             dac 802
             lac set
             rel 2s
             sza i
             jup sq3
dec sqt
             lac sc2
             sal 1s
add (1
             sub sat
             sma.+sza.-sip
             jop sog
             SDE.
             oma.
             ರಾದ ಕರ್ಮ
             .dr cus
             jmp au3
sq1,
s~2,
```

```
/outline compiler
/ac=where to compile to only jdr on
                                    /of-addrone of outline table
 define
             plinst A
lac A
            dae i oc
             idx oc
             terminate
            comtab A , B
            plinst A jap ocs
             lac B
             jmp oce
            terminate
                                    /oute in swen
            dan ocz
 ocs,
            dio i oc
            idx oc
 ocz,
            imp .
 oc,
            0
                                    /outline compiler proper
            dan oca
            lac i ocx
            dap ocg
            plinst (stf 5
            dap ocm
idx ocm
plinst (lee smi
plinst (lee smi
 ock,
            clf 6
            setup occ, 6
 ocj,
            lio .
                                    /cutline table
 ocg,
 och,
            cla
            rcl 3s
            dio oci
            lio (sum
                                    ואס בכסשמאם
            dispetch
            opr
            imp oci
imp oci
imp oci
 oco,
 ocq,
             jmp och
 ocp,
             jmp oc5
jmp oc6
 ocr,
```

```
olinst (szf 5
                                                  /7 code
                   add (4
                   ಗೆ೭೫ ೨೧೫
                   plinst con
                   plingt (dec Ex1
                   plinst (die syl
                   plinst (imp sch
                   plinst (clf 5 plinst (lac sem
                   plinst (cma
                  plinst (dac \overline{s}cm plinst (lac \overline{s}sm
                  plinst (dae ssm
plinst (dae ssm
plinst (lae ssm
plinst (lio ssd
plinst (dae ssd
plinst (dio ssd
                  plinst (lac ssc
plinst (lic ssn
                  plinst
                              (dac <u>c</u>sn
                  plinst (dio ssc
                  plinst ocm
 OCX,
                  jap.
 oem,
                  jmp .
ocn,
                  jap .
oci,
                  plinst (add San
                  jsp oes
                  lec (sub son
                 dec i oc
oce,
                  idx oc
                  jsp ons
                  plinst (1ch
                 lac (net db2 dac i oc
ocd,
                  idx oc
                 lic oci
count oce, och
                 idm ocg
                  jap oc.j
                 comtab (add sac, (add sam comtab (add sac, (aub cam comtab (aub sac) (aub sac comtab (add can, (aub aad
002,
003,
ocli,
005,
                 szf 6
oc6,
                 ქლე იცე
ცხე 6
                 plinet (dee See lee (dio Se)
lee (dio Se)
jup oed
elf 6
plinet (lee See
lee (lio Ge)
ocī,
                 Jag Sed
```

```
/display granitabless I store
 define
              sizmo
              edd 5-
             awap
              с жар
              ioh
             Ret 1162
             terminate
             dap bla
szs 60
 blp,
                                       10000
             Jap blx
             randon
             rar 9s
and (400700
             spa
             mor (377777) dac bx
             lee ron
ral 4s
and (400700
             spa
             nor (377777 dae by jsp bpt ich
             Jap .
blx,
             cap bor
bpt,
             random
             sar 9s
             sar Ós
             SPA
             cma
             srl 3s
             add (bds
             dap bin
             ola pli-opr
szf 4
jup bjc
sub nyí 1
bjl,
             swp
swb mm1 1
             jan bja-1
sub ry1
bjc,
             SWD
             sub mri
met 162
             bjm,
             ropest 10, atom
szf 6
bds,
             brx,
             0...2
```

dee bo

```
/background display - 3/13/60, to.
```

```
doffin
           dislis J,
                                                                                              dap frot?
dap frot?
                                                                                               dap fin+1
         fs,
                                                                                               dab fyn+R
id: fyn+R
                                                                                              lac /lco T sub Spe /right margin
         fin,
SME.
                                                                                              add (2000)
                                                                                            spq
jmp fuu+R
sub (1000
sal 6s
         frr,
         fou,
         fie,
                                                                                                                                                                             /Lio Y
                                                                                              lio
        fyn,
                                                                                            jda keb
xet dbî
                                                                                           stf 5
idx fyn+R
sad (lio 7,42
jup flp+R
        fid,
                                                                                             sed Cpo+R
                                                                                            jan Sit+R
dap Sin+R
                                                                                            idx fyn+R
Jmp fin+R
                                                                                            szf 5
        fuu,
                                                                                            jap
idx flo+R
idx flo+R
                                                                                                                                                                              /return
       ſx,
                                                                                           dec flots
law J
la
                                                                                             inp fid+R
                                                                                           lac (lic J
sad 170+1
jmp fm+1
dap fin+1
       flp,
                                                                                              lew J+
                                                                                            den fynda
Fhaif art
       fpo,
                                                                                            110
      îlo.
```

terminate

```
dofine
background
                     jap bek
termin
                     dap ber
szs 40
bek,
                    jup ben
jup ben
jup 1m
jup 2m
idu bec
and (1
                     SZE.
                    jsp Jm
law 3
and bee
bc1,
                    sza i
jsp Ma
isp bkc
jmp bey
law i 10
bc3,
                    dae blee
law 1
add fpr
                    spa
add (20000
dae fpr
                     jap 1m
boy,
                     1:2
bex,
                    dislis 1;, 10
dislis 2;, 20
dislis 3;, 30
dislis 4;, 40
2 m
2m,
3m,
ŭm,
                    00
bec,
blcc,
                     10000
fpr,
```

mul≂cus div=dis

start

nnn=nh4 2

```
/main control routine for aproachips
                                 /total number of colliding objects
nob=30
                                /delay for loop /loc of calc routines
           setup Etc, 5000
m10,
          init ml1, mtb add (nob
           dap mx1
nx1=mtb nob
           add (nob
           dap my1
                                1 5
ny1=nx1 nob
          add (nob
          dap ma1
                                / count for length of explosion or torp
na1=ny1 nob
          add (nob
          dap mb1
                                / count of instructions taken by calc routine
nb1=na1 nob
          add (nob
          dac mdx
                                / dm
ndx=nb1 nob
          add (nob
          dac mdy
                                / dy
ndy=ndx nob
          add (nob
                                /angular velocity
          dap mom
nom=ndy nob
           add (2
           dap mth
                                /angle
nth=nom 2
          add (2
           dac mfu
                                /fuel
nfu=nth 2
          add (2
                                 / no torps remaining
           dac mtr
ntr=nfu 2
          add (2
           dap mot
                                / outline of spaceship
not=ntr 2
           add (2
           dap mco
                                / old control word
nco=not 2
           add (2
           dac mhi
nh1=nco 2
           edd (2
           dae Th2
nh2=nh1 2
           add (2
           dae mh3
nh3=nh2 2
          add (2
dae may
nh4=nh3 2
```

```
4
            SZC A
            jmp . 4 law dj6 st? 4
            jmp . 3
law dj5
clf 4
            dap . 1
            lac .
            dac db1
            idx .-2
            met .-3
            dac db2
            law ssi
            xor mtb
            SZS
            jap mdn
            law ss2
            xor mtb 1
            sza
            Jmp mdn
                        / test if both ships out of torps
            law 1
            add ntr
            spa.
            jmp md1
law 1
            add ntr 1
            spa t
jmp mdn
md1,
            net tlf
                        / restart delay is 2% torpedo life
            sal 1s
            dac ntd
            jmp ml1
mdn,
            count ntd, ml1
            stf 1
stf 2
            law ss1
            xor mtb
            SZ2.
            clf 1
            sza i
            idx 1sc
            law ss2
            xor mtb 1
            SZE.
            clf 2
            sza i
            idm 2nc
            clf 2
            jup a
db1,
db2,
            0
            doy-:
dj5,
            dp:-4000
            dpy-1000 400
djб,
```

```
law mg2
                                    / test word control
  a1,
             dac cwg
              jmp a
             law cwr
dac cwg
  a40,
                         / here from start at 4
              jmp a6
1sc,
2sc,
             0
                         /scores
             0
             lac Ect
              STA
             jmp a5
count get, a5
             lac 1sc
             sas 2sc
              jmp a4
             lac fiu
             sad (jmp 4 jmp a4 law i1 dac gct
  a5,
             lat
             and (40
             sza 1
             jmp a2
  a4,
             jmp fil
             lat
             and (40
             SZZ
             jmp a2
             dzm 1sc
             dzm 2sc
  a6,
             lat
             rar 6s
             e.nd (37
             sza
             cme.
             dac get
  a2,
             clear mtb, nnn-1 / clear out all tables
             law ss1
             dae mtb
             law ss2
             dac mtb 1
             lac (200000
             dac rm1
             dae nyil
             cme
             dae mil 1
             dae ny1 1
lae (144420
             dae nth
```

```
/ start of outline program
law nnn
dac not
lio ddd
imp a3
                      / compile outline
jda oc
ot1
dec not 1
dap fil
jda oc
ot2
dap fi2 xct tno
dac ntr
dac ntr 1
lac foo
dac nfu+1 law 2000
dac nb1
dac nb1 1
xct mhs
dac nh2
dac nh2 1
jmp ml0
```

а3,

```
/ cotrol word get routines
              dap mg3
              cli
              iot 11
              rir 4s
              ರೆಬ್ಲಾ .
mg3,
              dap mg4
mg2,
              lat
              swap
              jmp .
              id: mth
              idx mfu
              idx mtr
              id: mco
              idx mot
              idx mom
              idz mh1
              idx mh3
              idx mh4
              idx mx1
ids,
              idx my1
              idx ma1
              \begin{array}{ccc} & \text{idx} & \underline{m} \text{b1} \\ & \text{idx} & \underline{m} \text{dy} \end{array}
              idx mdx
              lac .
                                          / 1st control word
ml1,
                                           / zero if not active
              sza i
              jmp mc1
                                           / not active
              dap . 1
              jmp .
mb1,
              lac : add <u>m</u>tc
                                          / alter count of number of instructions
              dae mte
              idx ml1
mq1,
              sad (lac mtb 1
              jmp idl
              sas (lac mtb nob
              ico ids
              background
jsp blp
                                          / display massive star / use up rest of time of main loop / repeat whole works
              count mtc, .
              imp ml0
```

```
col,
            dap con
            law 1
            add ml1
            sad (lac mtb ncb
            jmp cox-1
dap ml2
law 1
            add mx1
            dap mx2
            law 1
            add my1
            dap my2
            law 1
            add ma1
            dap ma2
            law 1
           add mb1
            dap mb2
           lac .
                                   / 2nd centrol word
m12,
                       / can it collide?
           spq
                                   / no
/ calc if collision
/ delta x
/ take abs val
           jmp mg2
lac .
mx1,
mx2,
            sub .
            spa
            ema.
           dac mt1
                                   / < EPSILON ?
            sub me1
           sma
                                   / no
            jmp mg2
           lac .
my1,
my2,
           sub .
            នបូន
            cma.
                                   / < epsilon ?
            sub me1
            sma.
                                   / no
            jrp mg2
           edd mt1
           sub me2
           spa.
           jmp con
idx mx2
idx my2
mq2,
                                   / end of comparison loop
           idx ma2
            idr mb2
           index ml2, (lac mtb nob, ml2
           idx cox
COX,
           jmp .
```

```
/routine to set explosion
           law 20
           dac i mb1
           dac i mb2
lac (mex 400000
                                  /EYPLODE
sex,
           dac i ml1
                                  / replace calc routine with explosion
           dac i ml2
                                 / duration of emplosion
           lac i mb1
           add.
mb2,
           cma
           sar 8s
           add (1
ma1,
           dac .
ma2,
           dac .
/ misc calculation routines
           / explosion
           lac i mdy
mex,
           sar 3s
           add i mx1
           dac i mm1
           lac i mdy
           sar 3s
           add i my1
dac i my1
           law mst
           dap msh
           lac i mb1
                                 / time involved
           ema cli-opr
           sar 3s
           dac mxc
           sub (140
           sma.
           idx msh
mz1,
           lac ran
           and (777
           ior (scl
           dac mi1
           randor
           ser 9s
           sir 9s
msh,
           met .
mi1,
           hlt
           edd i my1
           SWED
           add i mx1
           ida kob
           met db1
           count mxc, ms1
count i ms , mb1
dsp i ml1
           إلم الأشائ
          sor is
mst.
           sor 3s
```

```
/ torpedo cale routine
ter,
            jsp col
            jmp sex-3
           count i ma1, tc1
           lac (mex 400000
           dac i ml1
           law i 2
dac i ma1
           law 20
           dac i mb1
           jrop mb1
           lac i mx1
           sar 9s
xct the
           add i mdy
           dac i mdy
           sar 3s
           add i my1
dac i my1
           sar 9s
           mot the
           add i mdx
dac i mdx
           sar 3s
           add i nw1
           dac i mx1
           dispt i, i my1, 1
           jup mb1
/ hyperspace routines
/ this routine hardles a non-colliding ship invisibly
/ in hyperspace
hp1,
           count i ma1, mb1
           law hp3
                                 / next step
           dac i ml1
           Jaw 7
           dac f mb1
           random
           sor 9s
           sir Os
           net hr1
           add i mx1
           dac i mx1
           swap
add 1 my1
           dec i my1.
          dzm i mdm
dzm i mdy
           met h42
           dac i mai
           jmp mb1
```

```
/ this routine handles a ship breshing out of
 / hyperspace.
hp3,
              jsp col
              jmp sex
              count i ma1, hp6
              law 2000
              dac i mb1 lac i mh4
              add hur
              dac i mh/4
              random
             ior (400000
              add i mh4
             sma
             jmp pol
lac ! Th1
             dac i ml1
             lac ran
             scr 9s
             sir 9s
             xct hr2
             dac i mdy
dio i mdx
setup hpt, 3
             lac ran
             sar 6s
             dac i mom
lac ran
dac i mth
hp4,
             lac i mth
             sma
             sub (311040
             spa
             add (311040 dae : mth
             count hpt,hp4
count i mh2,hp7
dzm i mh2
             met hd3
dae i mh3
lae i mx1
dispt i i my1, 2
hp7,
hp6,
             jmp rb1
kcb.
             0
                                       /relocate for center display
             day loca
             lac keb
             szf 4
             ქოთ . რ
             sub nm1 1
             SWan
             sub ny1 1
             SVIED
             jmp 4cc1
             בית לעם
             Swan
             sub ny1
             ಡಚಬ್ಬಾ
```

kc1.

```
/ spaceship calc
ss1, jsp i cwg
dio scw
               jmp sr0
              jsp i cwg
rir 4s
              dic scw
srO,
               clf 6
               jsp col
              jmp sex
lio sew
              clf 6 cla-opr /update angle
              spi
              add maa
              ril 1s
              spi
              sub maa
              add .
mom,
              dac 1 mom
              szs 10
              jmp . 3
              dzm i mom
              ral 7s
ril 1s
              spi
              stf 6
              lio i mfu
              spi i
mth,
              add .
              sma
              sub (311040
              spa
              add (311040
              dac i mth
jda <u>s</u>in
              dac sn
              dzm \overline{b}x
              dzm by
              szs 60
              jmp bsg
              lac i mx1
              dac <del>t</del>1 mul <del>t</del>1
              scr 1s
              dac acx
              cla
              scr 2s
dio iox
lac i my1
              dac <del>t</del>1 mul <del>t</del>1
              scr 1s
dac acy
```

```
cla
scr 2s
swap
add Tox
swap
scl 2s
add acx
add acy
sub str
sma i sza-skp
jmp pof
add str
varsft
dac T1
jda <u>sq</u>t
mul t1
undosft
scr 9s
scr 8s
sza
jmp bsg
scr 1s
dio t1
integrate mx1, \overline{b}x integrate my1, \overline{b}y
lac i mth
jda cos
dac cs
sar 9s
xct sac
szf i 6
cla
add by
diff_mdy, my1, (sar 3s
lac sn
sar 9s
xct sac
cma
szf i 6
cla
add bx
diff mdx, mx1, (sar 3s
scale \overline{s}n, 5s, \overline{s}sn scale \overline{c}s, 5s, \overline{s}cn
lac i mx1
szf 4
sub nx1
szf i 4
sub nx1 1
sub ssn
dac sx1
sub \overline{s}sn
```

dac stx

bsg,

```
lac i my1 szf 4
                           sub ny1
szf i 4
sub ny1 1
add \overline{s}cn
                           dac sty
dac sty
                           scale \frac{1}{5}n, 9s, ssn scale \frac{1}{5}s, 9s, scn
                           dac sem
lac ssm
dac ssm
add scn
dac ssc
                           dac <u>s</u>sd
lac <u>s</u>sn
sub <u>s</u>cn
                           dac csn
                           cma.
                           dae esm
cla cli-opr
jda keb
                           xct db2
                           jmp i .
ioh
lio sew
mot, sp5,
sq6,
                         spi i / not blasting jmp sq9 / no tail ranct sar js, sar is, sre scale sn, 8s, san scale cs, 8s, sch count i mfu, st2 dzm i mfu jmp sqo
                           ril 2s
spl i
sq7,
                           jmp sq9
```

```
st2,
            Vince Sxi, Syi, set
            110 571
            met db1
            count src, sc7
            count 1 ma1, sr5
 sq9,
                                   / check if tory tube reloaded
                                  / prevent count around previous control word
            dzm i me'
 mco,
            lac .
            cma
            szs : 30
            clc and sew / present control word
            ral 3s
                                  / torredo bit to bit 0
            sma
            jmp sr5
                                   / no launch
            count 1 mtr, st1 dzm 1 ntr
                                  / check if torpedos exhausted /prevent count around
            jmp sr5
init sr1, mtb nob-1
st1,
                                             /search for unused object
            lac .
srī,
                                  / C if unused
            Jmp sr2
            law : 1
            add sr1
           dap sr1
           sas (lac mtb-1
            jap sr1
jmp sr5
                                 / no space for new objects
           lac (ter
sr2,
                                 / set up torpedo calc
           dac 1 sm1
           law nob
           add sr1
           dap ss?
lio stm
           SWP
           SZf 4
           add nm1
           szf i 4
           add nr1 1
           SWD
ss3,
           dio .
           add (nob
           dap ss4
           lio sty
           SWP
           szf 4
           add nyi
           SZI I A
           add ny1 1
           sup
ss4,
          dio.
```

```
add (nob
          . dep srb
add (nob
             dap sr7
             add (nob
             dap sr3 add (nob
             dap <u>sr4</u>
lac sn
             net tvl
             cma
             add i mdx
             dac .
lac cs
             met tril
             add i mdy
             dac .
             met rlt
                            / permit torp tubes to cool
             dac i ma1 / permit xct tlf / life of torpedo
             da.c .
             lac (lac mtb nob-1
             sub sr1
            sal 3s
add (30
sr7,
             dap .
lac scw
                                       / length of torp calc.
sr5,
             dac i mco
            count i mh3, mb1 dzm i mh3 lac i mh2
             sza i
             jmp mb1
lac scw
             and (600000
             xor (600000
             sza
             jmp mb1
            lec i ml1
dac i mh1
lec (hp1 400000
dac i ml1
             met hd1
            dac i ma1
             law 2
             dac i mbi
             jmp mb1
```

```
/ here to handle spaceships dragged into star
/ spaceship in star
            dzm i mdx
dzm i mdy
szs 50
pof,
            jmp po1
lac (377777
dac i mx1
            dac i my1
            lac i mb1 dac ssn
            count ssn, .
             imp mbi
            lac (mex 4000000 / new go bang dac i mli
po1,
            law i 10
            dac i ma1
            jmp mb1
/ outlines of spaceships
            111131
111111
111111
ot1,
            11:163
            31111
            146111
            111114
            700000
. 5/
            013113
ot2,
            1131 1
            116313
            1311*1
161151
111633
365114
            700000
. 5/
            variables
            constants
.-60/
            . 100/
                                    / space for retches
p,
```

```
/set size of spaceship
fss,
             dap fs1
             lac <u>f</u>ss
dac <u>sc</u>m
             dac ssc
             \frac{1}{2} dac \frac{1}{2} sch
             dac csm
             cma.
             dae csn
            dzm ssm
fs1,
             jmp .
f11,
             law .
                          /set roturn of compiled outline
             sub c21
            dac to
fi2,
             law .
            sub c21
dac t7
lac c23
dac t4
fis,
            szf 3
            lio 2sc
                         /get score
            szf i 3
lio 1sc
             scl 1s
             cla
             div c12
            hlt
             sza.
            jap fx1
            dio t3
fkr,
            law 400
             jda fss
             law fys
            dap frt
            idi t3
flt,
             cma
            dac t3
            law fus
            dap i t6
fus,
            lac c20
            szf 3
            Cu.a
            dac syllac t4
            add c?O
            dac t4
            dec smi
```

```
szf 3
                         /display spaceship
 fds,
             law not
             szf 13
             law not 1
             dap fug
idx t5
ral 9s
             cli
             met db2
             isp t3
fug,
             jmp i .
             jmp .
             law 4000
             jda fss
law fub
             dap 1 t6
             dap i t7
             lac c26
             dac sx1
             lac c20
             szf i 3
             cme.
             add c30
             dac sy1
             law i 2
             dac t3
jmp fds
szf 3
jmp 3
fub,
             jmp . 2 clf 3
             cl:
             iot 11
             dio ti
             law 21
             xor t1
             sza i
             Jmp fik
law 42
             xor t1
1 1 m
             sza
             imp fkg
             law a4+
             jmp fwt-1
law 4
             dap fiu
             add .
dac 51
isp 51
             jmp .-1
fiu,
```

```
dio E1
£x1,
            dec t3
            law fx2
            dap frt
            law 1100
            jda fss
            jmp flt
lio t1
fx2,
            jmp flcr
            szf 3
fkg,
           jmp fis
           jmp 4
law dj6
stf 4
           jnp . 3
law dj5
clf 4
           dap . 1
            lac .
            dac db1
            idx .-2
            xct.-3
            dac db2
            jmp fis
            12
            200000
            21
            -200000-30000
            -260000
            30000
            Õ
            0
            0
            0
            0
mtb,
                        / table of objects and their properties
start 4
```

Constants area, inclusive from to 2736 .3063

1 J	6077
1m	706
1q	6117
1sc	1345
2j 2m	6121 764 6141
20 28c 3J	1346 6143
3m	1042
30	6403
1 4 4 4	6405 1120
4 6 1 6 1 6 1 6 1 6 1 6 1 6 1 6 1 6 1 6	1347 1337
a2	1405
a3	1436
a40	1370 1342
a5 a6 acx	7747 1347 1337 1436 1342 1364 1377 2731 6673
acy	2731
bc1	667
be3	673
bec	11 76
bek	656
bcx	705
bcy	704
bds	544
bjl	5 3 0
bjm	5 43
bja	5 3 7
bke	1177
bke blp blx	464 5 1 1
bpt	512
bpx	645
bx	2704
by	2705
c12	3407
c21	3411
C25	3412 3413 3410
bpt bpx bsg bx c12 c21 c23 c26 c20 c30 co1	512 54554 62705 34112 34112 34112 16736 127670 127670
	100 1614
cs	2732
csm	2676
csn	2701
, T	-101

csx	146
cwg	2720 40 1331 1333 1333 1335 233 1337 250 24 133 27 32 32 33 47 73 32 33 33 34 37 37 37 37 37 37 37 37 37 37 37 37 37
Ab1	1331
ddd	1332 20
dj5	1333
ajo fds	3272
f11	3225
fid	24
fie	3347 36
fin	7
fis	3233 3355
fkg	3367
fkr	3247 55
fip	45
foo	3254 12
fou	15
fpr	1500
frr	14 3305
db2 ddd dj5 fds fil file fik fin fix fkr flo ffpr frt fs fss fug fwt fx fvx fvx fvx fvx	333335431151134333333333333333333333333
181 188	3224
fub	3325
fus	3262
fuu	34
fX	35 35
fx1 fx2 fyn fys	3356 3365
Гуп	50
fys get	3306 2721
erv.	32
nd1 Nd2	23 24
get gry hd1 hd2 hd3	25
HA HA HA HA HA HA HA HA HA HA HA HA HA H	3356 3365 2306 2721 32 24 25 17744 1775 2036
hp4 hp6 hp7	2036
hp7	2053
npc	2724
hr1 hr2	2053 2051 2724 26 27

.

hur	30
1d1	1472
ids	1504
iox	2730
kc1	2102
kcb	2060
ma1	1630
ma2	1631
	1631 13
maa	13
mb1	1517 1624
mb2	1624
mco	つ月に4
md1	1303
mdn	1307
mdx	2707
	2701
mdy	2/10
me1	1303 1307 2707 2710 16
me2	17
mex	1632
mfu	2711
mg1	1460
mge	1465
## S C	
mg3	1464
mg4	1471
mh1	2713
mh2	2714
mh3	2715
mh4	2716
mhs	5,
m11	1667
m11	1512
m12 m10	1556
m10	1201
mom	2123 2402
mot	2403
mq1	1522
	1604
mq2	
msh	1666 1704
mst	1704
mt1	2722
mtb	3422
mtc	2706
mth	2437
	0740
mtr	2/12
mx1	1501
mx5	1562
MXC	2723
my1	1571
my2	1570
mz1	1852
	エクンジ
na1	3232
nb1	2722 3422 27342 2732 2756 2756 2757 2757 2757 2757 2757 275
nco	3704
ndx	3612

ndy nfu nh1 nh2 nh3 nh4 nnn nob not ntth ntr nx1 ny1 oc1 oc2 oc4 oc6 oc6 occ ocd occ occ occ occ occ occ occ occ	46600246 2274022 333333333333333333334444444244770013 3333333333333333333344444424770013 33333333333333333334444444770013 34770013 347
sex	1620

t123n 5123679tx1234567c01234acdimn12rxy11234567ccchinvssssssssssssssssssssttttttttttttttttt	61147022212221222222222222222222222222222
---	---

v2 3 xys 2664 xyt 2667

L

```
spacewar 4.3 5/17/63 ddb . bt 1
 3/
            jap sbf
                                  / ignore set, break
            jmp a40
                       / use test word for control, not lot 11 co
            វូមភ្ ខ.1
/ interesting and often changed constants
/symb loc usual value (all instructions are executed,
           / and may be replaced by jds or jsp)
tno,
       6,
           law 1 41
                                  / number of torps + 1
tv1, 7,
           sar 4s
                       / torpeds relocity
rlt, 10,
                      / torpedo reload time
           law 1 20
           law : 140
tlf, 11,
                                  / torpedo life
foo, 12,
                      / fuel supply
          -20000
                      / spaceship angular acceleration / spaceship acceleration / star capture radius
maε, 13,
          10
          sar 4s
sac, 14,
str, 15,
           100
me1, 15,
          6000
                      / collision "radius"
me2, 17,
                      / above/2
           3000
ddd, 20,
                      / O to save space for ddt
/ amount of torpedo space warpage
/ number of hyperspace shots
          -0
the, 21, mhs, 22,
           sar 9s
           law i 10
hd1, 23,
          law 1 40
                      / time in hyperspace before breakout
hd2, 24,
          law i 100
law i 200
                                  / time in hyperspace breakout
hd3, 25,
hr1, 26,
                                  / time to recharge hyperfield generators
          scl 9s
                      / scale on hyperspatial displacement
hr2, 27,
                      / scale on hyperspatially induced velocity
hur, 30,
ren, 31,
gry, 32,
                      / hyperspatial uncertancy
          40000
                      / random number / gravitational constant
           0
           sar 5s
/ place to build a private control word routine.
/ it should leave the control word in the io as follows.
/ high order 4 bits, rotate ccw, rotate cw, (both mean hyperspace)
   fire rocket, and fire torpedo. Low order ! bits, same for
     other ship. Routine is entered by jsp cwg.
40/
cwr,
                      / normally lot 11 control
          jmp mg1
. 20/
          / space
```

```
/ routine to flush secuence breakes, if they occur.
sbf,
              tyi
lio 2
              lac 0
              lsm
              jmp i 1
              define
xincr X,Y,INS
              lac Y
              INS ssn
              dac Y
              lac \frac{X}{S} INS sen
              dac X
              term
             define
yincr X,Y,INS
             \begin{array}{cc} \text{lac} & \underline{Y} \\ \text{INS} & \overline{\text{scn}} \end{array}
             dac Y
             lac X
             -INS+add+sub ssn
             dac X
             terminate
             define
dispatch
             add (. 3
             dap . 1
             jmp .
             term
             define
dispt A,Y,B
             repeat 6
                           B=B+B
             lio Y
szs 20
             jda kcb
             dpy-A+B
             term
             define
scale A,B,C
             lac A
             sar B
             dac C
             term
```

```
define
diff V,S,SF
             add i V
dac i V
xct SF
             add i S
dac i S
             term
             define
random
             lac ran
             rar 1s
xor (355670
add (355670
             dac ran
             term
             define
ranct S,SS,C
             random
             S
             SS
             sma
             cca
             dac C
             terminate
```

```
varsft
              dzm Tys
dac 51
idx Tys
idx Tys
idx Tys
v2,
               scr 2s dac t1
               SZZ
               jmp v2+R
               ser 2s
               swap
               terminate
define
              undosft
              dac <u>t</u>1
              dio \overline{t}^2 lac \overline{x}ys add sft
              dap .+1
              lac .
              dac .+6
              dac .+6
nor (10000
dac xyt
lac t1
dio t2
                                           / change ser to sel or sel to ser.
              scr.
              ser .
              terminate
define
              integrate A,B
              cli
              lac : A
              scr 9s
scr 1s
div 11
              hlt
              cma+cli-opr
              xet Tyt
              xct grv
              dac B
              terminate
sft,
              lac .-1
              ser 7s
              ser és
              scr 5s
scr 4s
              sor 3s
              sor 2s
              ser 1s
              sem
              scl 1s
```

define

```
/sine-cosine subroutine · Adams associates
/calling sequence= number in AC, jda sin or jdacos.
/argument is between +2 pi, with binary point to right of bit 3.
/answer has binary point to right of bit 0. Time = 2.35-? ms.
/changed for auto-multiply , ddp 1/19/63
cos,
           dap csx
           lac (52210
           edd cos
           dac sin
           jmp .+4
sin,
           dap csx
           lac sin
           spa
           add (311040
511,
           sub (62210
           sma
           jap si2
           add (62210
s13,
           ral. 2s
           mul (242763
           dac sin
           mul sin
          dac cos
mul (756103
add (121312
           mul cos
           add (532511
           mul cos
           add (144417
           mul sin
           scl 3s
           dac cos
           Mor sin
           Sma
           jmp csx-1
lac (377777
           lic sin
           spi
           cma
           jap csx
           lac cos
           jap .
esm,
si2,
           cma
           add (62210
           sma.
           jmp si3
          edá (62210
           ರ್ಣ
           jrp .+3
           sub (62210
           jmp si3
```

sub (62210

```
/integer square root
/input in ac, binary point to right of bit 17, jda sqt/answer in ac with binary point between bits 8 and 9 /largest input number = 177777
sqt,
              0
              dap sqx
              law i 23
              dac sc1
              dzm sq2
              lic sct
              dzm sgt
sq3,
              isp sq1
              ;mp .+3
              lac sq2
sąx,
              jmp .
              lac sq2
              sal 1s
              dac sq2
              lac set
rel 2s
              sza 🗅
              jmp sq3
dac sqt
              lac sc2
              sal 1s
             add (1
              sub sqt
              sma+sza-skp
              imp sq3
             spa
              cma
              dae set
              idx sq2
              jmp sq3
sq1,
sq2,
             0
```

```
/outline compiler
/ac=where to compile to, call | jda oc
                                    /ot=address of outline table
define
            plinst A lac A dac i oc
            idx oc
            terminate
define
            comtab A, B
            plinst A
            jsp ocs
lac B
            jmp oce
            terminate
ocs,
            dap ocz
                                   /puts in swap
            dio i oc
            idx oc
            dio i oc
            idm oc
ocz,
            jmp .
oc,
           0
                                   /outline compiler proper
           dap oex
lac i oex
           dap ocg
plinst (stf 5
           dap ocm
           idx ocx
           plinst (lac sx1 plinst (lio sy1
ock,
           clf 6
           setup occ,6
ocj,
೦೦ವ,
           lio . .
                                   /outline table
och,
           cla
           rcl 3s
dio oci
lio (rcl 9s
           dispatch
           opr
           jap oci
oco,
            Soo qmi
           jmp och
ocq,
ocp,
oer,
            jmp oc5
            jmp och
```

```
plinst (szf 5
                                     /7 code
               add (4
               dap ocn
               plinst ocn
                         (dac 5x1
               plinst
                         dio sy1
               plinst
              plinst
                         (clf 5
              plinst
                         (lac son
              plinst
                        (cma
(dac <u>s</u>em
              plinst
              plinst
                        (lac ssm
              plinst
              plinst (cma
plinst (dac ssm
plinst (lac csm
plinst (lio ssd
plinst (dec ssd
              plinst (die csm
              plinst (lac ssc
              plinst (lio csn
plinst (dae csn
plinst (dio ssc
              plinst ocm
oem,
              jmp .
ocm,
              jmp .
ocn,
              jmp .
oc1,
              plinst (add ssn
              isp ocs
lac (sub sen
              dac i oc
oce,
              idx oc
              jsp ocs
              plinst (ich
              lac (dpy-4000
ocd,
              dae i oc
              ldm oc
              lio oct count oce, och
              idx occ
              ျှံကဘု ဝင့
              comtab (add som, (add ssm
oc2
oc3,
              comtab (add ssc, (sub csm comtab (sub scm, sub ssm comtab (add csn, (sub ssd
ocl,
oc5,
              szf 6
              stî 6
jmp oc9
              Plinst (dac ssa
              lec (dio ssi
              in ood
009
              plinst (lac saa
lac (l'o ssi
              ೆಬ್ ೦೦ರೆ
```

```
/display gravitational star
define
             starn
             add bx
             swap
add by
             swap
             ioh
             dpy-4000
             terminate
blp,
             dap blx
                                       /star
             szs 60
             imp blx
             random
             rar 9s
and (400700
             spa
             xor (377777 dac bx
             lac ran
             ral 4s
             and (400700
             spa
            mor (377777
dae by
jsp bpt
ioh
             jano.
blm,
bpt,
             ממל מגה
             randon
             sar 9s
sar 6s
             spa
             cma
             sal ?s
add (bds
            dap bjm
cla cli cli 6-opr-opr
szf i 20
jop bjx-1
             sub nyl
             SURP
             sub nx1
             dpy-4000
bjm,
             jmp.
             repeat 10, storp
bds,
             88f 6
             imn
stf 6
bom,
             OME
             SHOP
             amo
             SMED
```

ing bic

```
/background display . 2/12/62, nms.
            dofine
disl's J,
            Can firts
            olf 5
            lac flotR
            dan from
fs,
            dap fin+R
            dap fyn+D
            dy fyn+R
fin,
            lac
                       /led M
                       Inight manning
            sub for
            sma
            aub (20000
           add (2000
frr,
            8 DC
fou,
            jmp fuu+R
           sub (1000 sal 8s
fie,
            110
                       /lic Y
fyn,
           szs 20
           jda kob
doy-i
           stf 5
           idx fyr+R sad (lio 0+2
fid,
            imp flo+R
           sad fpo+R
            imp fx+R
           dan fin+R
           idx fyn+R
jmp fin+R
fuu,
           szf 5
           jmp
idm flo+R
fx,
                       /return
           idx flo+R
           cas (0+2
           jmp fid+R
           law J
           dac flotR
           imp fid+R
flp,
           lac (lio J
           sad fpo+R
           jmp fx+R
           dap fin+R
           law J+1
           dap fyn+R
jmp fin+R
           110
```

terminate

fpo, flo,

```
defino
 background
                    jsp bek
                    termin
                   dap bem
szs 40
 bck,
                  jmp ben
jsp 1m
jsp 2m
idm bee
and (1
                   SZC
                  jsp 3m
lew 3
bc1,
                  and occ
                  sza i
jsp ym
isp bke
jmp boy
law i 10
bc3,
                  dae bkc
                  law 1 1
add 192
                  jab 7m
gwc low
gwg (50000
abs
bcy,
bex,
                   jug
                  dislis 1;, 1q
dislis 2;, 2q
dislis 2;, 3q
dislis 4;, 4q
1m,
2n,
3m,
ŭm,
                  0
bee,
                  0
blic,
for,
                  10000
```

mul=mus div=dis

start

```
/main control routine for spaceships
 nob=30
                                  /total number of colliding objects
 mlO,
                                  /delay for loop
/low of calc routines
           setup mtc, 5000
           init mli, ato add (nob
           dap arti
con dim=1xa
           add (nob
           dap nyi
                                 1 7
ny1=nx1 nob
           add (nob
                                 / count for length of suplosion or torp
           dap ma1
nsi=nyi nob
           add (nob
                                 / count of instructions taken by calc routine
           dap mbl
nbi=nsi nob
           add (nob
                                  1 200
ndu=nbl nob
           add (neb
                                 / 35
ndy=ndn .cob
           add (nob
           dap con
                                 /Enguler relocity
nom=ndy nob
           add (2
           dap mth
                                 / angle
nth=nom 2
           edd. <u>(</u>2
           dec miru
                                 /fuel
nfu=nth 2
           add (2
           dae ftr
                                 / no torps recaining
nto=nou 2
           add (2
           dap not
                                / outline of spaceship
not=ntr 2
           add (2
           dan aco
                                 / old control word
nco=not 2
           add (2
           dac mhi
nhi=nco 2
           £dd (2
           Mac Th2
nh2=nhi. 2
           add (2
doa mh3
nh3=nh2 2
           000 12
           रहित कोर्न
ah4=nh3 2
inn-nhh o
```

```
law cs1
             Mor mib
            3 Z L
            jup mdn
law ss2
            mor mtb 1
            SZa
            jap adn
law 1
                        / test if both ships out of torps
            add ntr
            spa
jup md1
lew 1
            add ntr 1
            spa i
jmp mdn
met tlf
                        / mastert delay is 27 tompodo life
md1,
            sal 1s
dae ntr
            jop ml1
mdn,
            count ntd, ml1
            stf 1
stf 2
            law sst.
            cor mtb
            372
            clf 1
szz f
            idy isc
            law ss?
            more with 1
            SZE
            clf 2
            gze :
            id- 2sc
            clf 2
            Jap a
```

```
16% <u>13</u>2
486 650
165 6
 21,
                                            I test we war rection
               len err
dee duc
jep e5
 e.40,
                               ל לה לתפלת נרטף בקייני /
               0
 1sc,
                              /scores
 2sc,
               dzm 8j1
dzm 8j2
 a,
               lac Ect
               SME
               jmp a5_
count get, a5
               lac 1sc
ses 2sc
               jap all
law <u>i</u> 1
dac sco
a5,
               lat
               and (40 sza i
               jmp a2
jmp fill
lat
a4,
               and (40
               sza
               Se qui
               dzm 1sc
               dzm 2sc
26,
               lat
              ran 6s and (37
               SZa
               cma.
              dae get
22,
              clear utb, rnn-1 / clear out all tables
              law ss1
              dec mtb
              law ss2
              dae mtb 1
lee (20000
              dae nri
              dae ny1
              ста
              dac nx1 1
dae ny1 1
lac (144420
              dee ath
```

```
/ start of outline program
            law nnn
            dac not
            lio ddd
            spi i
            imp a3
ida oc
ot1
                                    / compile outline
a3,
            dec not 1
            dan fil
            ot2
            dap fi2 met the
            dac ntr
dac ntr 1
lac foo
            dac nfu
            dac nfu+1
            law 2000
            dae nb1
            dac nb1 1
            xct mlis
            dac nh2 dac nh2 1
            jmp mlO
```

```
/ control word got routines
              dap __g3
iot 1/
jep 3a
mg1,
811,
              0
              dec E1
              iot 111
jsp Sa
8;2,
              lio E1
              ril 4s
              ror Es
mg3,
              jmp .
mg2,
             dap mg4
              lat
              swap
mg4,
              jmp .
idl,
             idx mth
             idx mfu
              idx mtr
              idx mco
             idx mot idx mon idx mh1 idx mh2 idx mh3 idx mh4
ids,
              idx mx1
             idx my1
              idz ma1
             idx mb1 idx mdy
             idn mdn
m11,
             lac .
                                         / 1st control word
                                         / zero if not active
             ៩៩៦ ាំ
              jmp mq1
                                         / not active
             dap . 1
             jmp .
lac .
add inte
mb1,
                                        / alter count of number of instructions
             dae nte
             idz ml1
mc1,
             sad (lac mtb 1
             jmp idl
sas (lac ntb nob
              imp ids
             background
                                         / display massive star / use up rest of time of main loop / repeat whole works
             jsp blp count mtc, .
             jmp mlo
```

```
dap 8ay
dap 8ax
1dx 8ax
clf 7
spi 5
stf 5
stf 6
ril 1
spi 8ao
 8a,
8ay,
                        lac
rir 8s
                        spi
cla
rin 1s
spi
                        law 2
dae i Say
                       rir 8s
spi
jmp 8aq
rir 5s
spi
ior (14
8ad,
                        mir is
                        spi
for (1
jmp Sae
8ao
                        cla
                       rir 9s
spi
law 2
jmp 8ad
                       rir 5s
sp:
ior (1
rir 1s
Saq,
                       8aa,
Sex,
                        jmp
```

```
col,
           roo qab
           law 1
           add ml1
           sad (lac mt) nob
           jmp cox-1 dap m12
           law 1
           add mx1
           dap mx2
           lav: 1
add my1
           dap my2
           law 1
           add ma1
           dap ma2
           law 1
           add mb1
           dap mb2
ml2,
           lac .
                                  / 2nd centrol word
           pgs
                       / can it collide?
                                  / no
/ calc if collision
/ delta x
           jmp mc2
mx1,
           lac .
mx2,
           sub .
           spa
                                  / take abs val
           cma
           dac mt1
           sub me1
                                  / < EPSILON ?
           sma.
           jmp ma2
                                  / no
my1,
           lac .
my2,
           sub .
           spa
           cma
           sub me1
                                  / < epsilon ?
           sma
           jmp mq2
                                  / no
           add mt1
           sub me2
           spa
           jmp cox
idx mx2
mq2,
                                  / end of comparison loop
           idx my2
           idm ma2
           idx mb2
           index ml2, (lac mtb ncb, ml2
           idx cox
cox,
           jmp .
```

```
/routine to set explosion
            law 20
            dac i mb1
            dac i mb2
           lac (mex 400000
 sex,
                                  /EXPLODE
           dac i ml1
                                  / replace calc routine with explosion
           dac i ml2
                                 / duration of explosion
           lac i mb1
mb2,
           add .
           oma.
           sar 8s
           add (1
ma1,
           dac .
ma2,
           dac .
/ misc calculation routines
           / explosion
           lac i mdx
mex,
           sar 3s
           add i mx1
           dac i mx1 lac i mdy
           sar 3s
           add i my1
           dac i my1
           law mst
           dap msh
           lac i mb1
                                 / time involved
           cma cli-opr
           sar 3s dac mxc
           sub (140
           sma
           idx msh
mz1,
           lac ran
           and (777
           for (scl
           dac mii
           random
           ser 9s
           sir 9s
msh,
           xct .
m:1,
           hlt.
           add i my1
           swap
           add i mx1
           szs 20
           jda heb
dpy-1 300
count mxc, mz1
           count i me1, mb1
           dzm i ml1
           jmp mb1
mst,
          ser 1s
           ser 3s
```

```
/ torpade male routine
            jsp col
imp sex-3
ter,
            count i mai, tei
            lac (mex 400000 dac i ml1
            law i 2
            dac i ma1
            law 20
            dae i mbi
            jmp mb1
tc1,
            lac i mx1
            sar 9s
xct the
            add i mdy
            dac i mdy
           sar 3s
add i my1
            dac i my1
           sar 9s
xct the
add i mdx
            dac i mdx
           sar 3s add i mx1
            dac i mx1
            dispt i, i my1, 1
            jmp mb1
/ hyperspace routines
/ this routine handles a non-colliding ship invisibly
/ in hyperspace
hp1,
            count i ms.1, mb1
            law hp3
                                   / next step
           dac f ml1 law 7
           dac i mb1
           random
           ser 9s
           sir 9s
act hr1
           add i mx1
           dac i mx1
           g.swa
           add i my1
           dac i myi
           dzm i mdx
dzm i mdy
           met hd2
           dac i ma1
            jap mb1
```

```
/ this routine handles a ship breaking out of
/ hyperspace.
hp3,
             isp col
             imp sex
            count i ma1, hp6
            law 2000
            dac i mb1 lac i mh4
            add hur dac i mh4
            random
            ior (400000
add i mh4
            sma
            jmp po1
            lac i mh1
dac i ml1
            lac ran
            scr 9s
            sir 9s
            xct hr2
            dac i mdy
dio i mdx
            setup hpt,3
            lac ran
            sar 6s dac t mom
            lac ran
            dac i mth
hp4,
            lac i nth
            sma
            sub (311040
            soa
            add (311040
            dac i mth count hpt, hpl
            count i mh2, hp7 dzm i mh2
            xct hd3 dac i mh3
hp7,
            lac i mx1
hp6,
            dispt i, i my1, 2
            jmp mb1
kcb,
                                     /relocate for center display
            dap kc1
            swap
            sub ny1
            swap
            lac hob
            sub nx1
            imp .
kc1,
```

```
/ spaceship calc_ss1, jsp i cwg dio sew
               jmp erO
              ss2,
              dio scw
srO,
              clf 6
sc1,
              jsp col
jmp sex
lio scw
              clf 6 cla-opr
                                         /update angle
              នក្វ
              add maa
              ril 1s
              spi
              sub maa
mom,
              add .
              dac i mom
              szs 10
              jmp . 3
              dzm i mom
              ral 7s
              ril 1s
              spi
              stf 6
              lio i mfu
spi j
              clf 6
mth,
             add .
              sma
              sub (311040
              spa
             add (311040 dac i mth
              jda <u>s</u>in
             dac sn
             dzm bx
             dzm by
szs 60
             jmp bsg
             lac i my1
             dac £1 mul £1
             ser <u>1</u>s
dae aex
             cla
             sor 2s
dio Tox
             lac i my1
dac t1
mul t1
ser 1s
dac acy
```

```
cla
scr 2s
gswap
add Tox
gwap
scl <u>2</u>s
add acx
add acy
sub str
sma i sza-slop
jmp pof
add str
varsft
dac t1
ida sot
undosft
scr 9s
scr Ss
sza
jmp bsg
ser 1s dio 51
integrate mm1 bx
integrate my1, by
lac i mth
jda cos
dac cs
sar 9s
rct sac
szf i 6
cla.
add by
diff mdy, my1, (sar 3s lac sn
sar 9s
xct sac
cma
szf i 6
cla
add bu
diff mdx, mx1, (ser 3s scale sn, 5s, sen lac f mx1
szs 20
sub <u>n</u>x1
sub ssn
dac sv1
sub ssn
dac str
```

bsg,

```
lec i my1
              szs 20
             sub ny1
add scn
             dac Sy1
             add scn
             dac sty
             scale sn, 9s, ssn
             scale cs, 2s, sen
             dec sem
             lac <u>s</u>sn
             dac ssm
             add scn
             dac ssc
             dac ssd
             lac \overline{s}sn
             sub scn
             dac csn
             cma.
             dac csm
             cla cli-onr
             szs 20
             ida keb
             dpy-4000
             jup i.
mot, sp5,
sq6,
             lio scw
             ril 2s
             spi i
                                      / not blasting
                                     / no tail
             imp sa9
            ranct ser 9s, ser 4s, sro
            scale \frac{8}{5}1, \frac{9}{5}8, \frac{8}{5}29 scale \frac{1}{5}8, \frac{1}{5}5 scale \frac{1}{5}8, \frac{1}{5}5 scale
sq7,
            count i mfu, st2
            dzm i mfu
            jmp sqg
st2,
            yincr \overline{s}x1, \overline{s}y1, sub
            dispt i sy1
            count src, sc7
            count : ma1, sr5
                                     / check if torp tube reloaded
            dzm : ma1
                                     / prevent count around
            lac .
mao,
                                     / previous control word
            cma
            szs i 30
            clc
            and scw
                         / present control word
            ral 3s
                                     / torpedo bit to bit O
            jmp sr5
                                     / no launch
            count i mtr, st1
                                     / check if torpedos exhausted
            dzm i mtr
                                                 / prevent count around
            jmp sr5
st1,
            init sr1, mtb nob-1
                                                 /search for unused object
sr1,
            lac .
            sza i
                                     / 0 if unused
            jmp sr2
            law i 1
            add sr1
            dap sr1
            sas (lac mtb-1
```

```
jmp sr1
            hlt
                                     / no space for new objects
             jmp sr5
sr2,
            lac (tcr
                                    / set up torpedo calc
            dac i sr1
            law nob
            add sr1
            dap gs3
            lio stx
ss3,
            dio
            add (nob
            dap ss4
            lio sty
            dio . add (nob
ss4,
            dap sr6 add (nob
            dap sr7
            add (nob
            dap sr3
            add (nob
            dap <u>s</u>r4
lac <u>s</u>n
            xct tvl
            cma
            add i mdx
            dac .
lac cs
sr3,
            xct tvl
            add i mdy
sr4,
            dac . xct rlt
            dac i ma
                                    / permit torp tubes to cool
            xct tlf / life of torpedo
sr6,
            dac
            lac (lac mtb nob-1
            sub sr1
            sal 3s
add (30
sr7,
            dap .
lac scw
                                   / length of torp calc.
sr5,
            dac i mco
            count i mh3, mb1
dzm i mh3
            lac i mh2
            sza i
            jmp mb1
            lac scw
            and (600000
xor (600000
            sza
            jmp mb1
            lac i mli
dac i mhi
lac (hpi 400000
            dac i ml1
            xet hd1
            dac i ma1
law 2
            dac i mbi
```

```
/ here to handle spaceships dragged into star
/ spaceship in star
           pof,
           szs 50
           jmp po1
lac (377777
           dac i mx1
           dac i my1
           lac i mb1
           dac ssn
           count ssn, .
           jmp mbi
           lac (mex 400000 / now go bang
po1,
           dac i mli
law i 10
dac i ma1
           jmp mb1
/ outlines of spaceships
ot1,
           111131
           11111
           111111
           111153
           31 11
           14611
           1:1:14
           700000
. 5/
           0131:3
1131:
116313
131111
ot2,
           161.51
1.1633
365114
           700000
. 5/
           variables
           constants
.-64/
          . 100/
                                 / space for patches
P.
```

```
/display score routine
```

```
/set size of spaceship
fss,
             dap fs1
             lac fss
             dac scm
             dac ssc
             dec ssd
             dac sen
             dac csm
             cma
             dac csn
             dzm <u>s</u>sn
             dzm ssn
fs1,
             jmp .
                          /set return of compiled outline
f11,
             law .
             sub c21
dac t6
fi2,
             law .
             sub c21 dac t7
             lac c23
fis,
             szf 3
lio 2sc
szf i 3
lio 1sc
                          /get score
             scl 1s
             cla
div c12
             hlt
             SZZ
             jup fx1
dio t3
fkr,
             law 400
             jda fas
             law fys
             dap frt
idz t3
flt,
             Cina
             dae t3
             lew fus
dap 1 t6
dap 1 t7
             lac c20
fus,
             szf 3
             ema
             dae syllac th
             edd c30
             dac t4
             dec sxi
```

```
szf 3
                          /display apaceship
 fds,
              law not
              szf i 3
              law not 1 dap fug
              ral 9s
              cl:
              dpy-4000+700
              lop t3
              jap i .
jap .
fug,
frt,
fys,
             law 4000
             jda fss
law fuh
dap i t6
dap : t7
             lac c26
             dac sx1
             lac c20
             szf i 3
             cma.
             add c30
             dac syllaw i 2 dac t3
             jmp fds
             szf 3
fub,
             jmp . 3
             stf 3
             jmp . 2 clf 3
             iot 11
dio t1
             lot 111
             dio t2
             law 1 and t1
             and t2
             SZ2.
             sza 1
             jmp fis
law a#+
             dap fiu
             imp fwt
filt,
             dap fiu
SW5,
             add .
             dec <del>1</del>1
1sp 71
jmp .-1
fiu,
```

```
dio 51
dac 53
law fm2
 fx1,
                dan fat
                law 1100 jds fss imp flt tio ti
fx2,
c12,
c20,
               12
200000
c21,
c23,
c26,
                21
               -200000-30000
-260000
               30000
0
0
0
0
t7,
                               / table of objects and their properties
mtb,
start 4
```

```
spacewar 4.3 5/17/63 ddp . pt 1 - pass 1 spacewar 4.3 5/17/63 ddp . pt 2 - pass 1 stars by prs for s/w 2b - pass 1 f nx1=mtb nob f

nx1=mtb nob ny1=nx1 nob start f - pass 1 spacewar 4.3 5/17/63 ddp . pt 1 - pass 2 spacewar 4.3 5/17/63 ddp . pt 2 - pass 2 stars by prs for s/w 2b - pass 2 stars by prs for s/w 2b - pass 2 spacewar 4.3 syms 5/23/63 jcm

Constants area, inclusive from to 2763 3111
```

1111222233334444888888888888888888888888	74 731 143235170035223045523501446 701321 143235170035223045523501446 60131613104402425560344233343555510432210634333322222 6761616161711111111111111111111111
oay 118 318 34 40 aasaa440 aasaaccisckxysbobbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbb	1003304556235014466 111111111111111111111111111111111

Coccessions of the coccession	31065736 5 250 3 317 4 2 5 4054 5 21 66 5126 31 11 2 2 2 1 2 4 2 3 3 3 5 4 3 1 5 1 1 3 4 3 3 3 3 3 3 3 3 3 3 3 2 3 2 3 2 2 2 2
hpt	2751

fico ndy unital nnin nnot nnin nnot nnin nnot nnin nnot nnin nnin	06662±4602 6640466 7286512±4602 66440466 7386577777370 7774510 506420011 253201344657227557004 210 338333333333333333444444444355701344657227552004 210 3383333333333333334444444443557013446572233223223223116222
---	--

SCW	2752			
sex	2752 1667		16	
sft	66			
s11 s12	112 147			
si3	117			
sin	106			
sn	2753			
sp5	2440			
sq1	220 2 21			
sq2 sq3	171			
sq6	2441			
sq7	2466			
sq9	2506			
sqt	162 174			
sqx sr1	2527			
sr2	2541			
sr3	2570			
sr4 sr5	2574 2606			
sr6	2600			
sr7	2600 2605			
src	2762			
sr0 ss1	2152 2144			
SSS	2147			
ss3	ē 547			
ss4	2547 2553 2727			
ssa	2727			
ssc ssd	2725 2724			
ssi	2730			
ssm	2722			
ssn	2707			
st1 st2	2525 2472			
str	15			
stx	15 2760			
sty	2761			
sx1 sy1	2715 2716			
t1	2712			
t2	2713			
t3 t4	3431			
₩ ₩	2712 2713 3431 2432 3433 3435 3435 1775			
t5 t6	3434			
t7	34 3 5			
tc1	1771			
ter	1.100			
the tlf	21 11			
DOM 170	arism arism			

.

tno 6 tvl 7 v2 3 xys 2711 xyt 2714

•

```
spacewar 4.2 5/11/63 ddp .
 3/
            jmp sbf
                                  / ignore sec. break
            jmp a40
                       / use test word for control, not iot 11 co
            imp a1
 / interesting and often changed constants
 /symb loc usual value (all instructions are executed,
            / and may be replaced by jda or jsp)
       б,
 tno,
            law i 41
                                  / number of torps + 1
 tvl,
       7,
            sar 4s
                       / torpedo velocity
rlt, 10,
                       / torpedo reload time
            law i 20
tlf, 11,
            law i 140
                                  / torpedo life
foo, 12, maa, 13,
            -20000
                       / fuel supply
           10
                       / spaceship angular acceleration
sac, 14,
           sar 4s
                       / spaceship acceleration
                      / star capture radius / collision "radius" / above/2
str, 15,
           100
me1, 16,
           6000
me2, 17,
           3000
ddd, 20,
                      / O to save space for ddt
/ amount of torpedo space warpage
/ number of hyperspace shots
           -0
the, 21,
           sar 9s
mhs, 22,
           law i 10
hd1, 23,
           law i 40
                      / time in hyperspace before breakout
hd2, 24,
           law i 100
                                  / time in hyperspace breakout
hd3, 25,
                                  / time to recharge hyperfield generators
           law i 200
hr1, 26,
           scl 9s
                      / scale on hyperspatial displacement
hr?, 27,
           scl 4s
                      / scale on hyperspatially induced velocity / hyperspatial uncertancy
hur, 30, ran, 31,
           40000
                      / random number
grv, 32,
                      / gravitational constant
           sar 6s
/ place to build a private control word routine.
/ it should leave the control word in the io as follows.
/ high order 4 bits, rotate ccw, rotate cw, (both mean hyperspace)
     fire rocket, and fire torpedo. Low order 4 bits, same for
     other ship. Routine is entered by jsp cwg.
40/
cwr,
           jmp mg1
                      / normally iot 11 control
. 20/
           / space
```

```
/ routine to flush sequence breakes, if they occur.
sbf,
               tyi
              lio 2
              lac 0
              lsm
              jmp i 1
              define
xincr X, Y, INS
              \frac{1}{1} INS \frac{Y}{5} sn
              dac Y
              \frac{1}{1} \frac{X}{5} 
              dac X
              term
              define
yincr X, Y, INS
              \begin{array}{c} \text{lac} \ \underline{Y} \\ \text{INS} \ \overline{\text{scn}} \end{array}
              dac Y
              lac X
              -INS+add+sub ssn
              dac X
              terminate
              define
dispatch
              add (. 3
              dap . 1
              jmp .
              term
              define
dispt A, Y, B
              repeat 6
                            B=B+B
              lio Y
              dpy-A+B
              term
              define
scale A,B,C
              lac A
              sar B
              dac C
              term
```

```
define
diff V,S,SF
             add i V
dac i V
             xct SF add 1 S
             dac i S
              term
             define
random
             lac ran
rar 1s
xor (355670
add (355670
             dac ran
             term
             define
ranct S,SS,C
             random
S
             SS
             sma
             cma
             dac C
```

terminate

```
define
               varsft
               dzm xys
dac t1
idx xys
idx xys
lac t1
v2,
               scr 2s
dac T1
               sza
               jmp v2+R
               scr 2s
               swap
               terminate
define
               undosft
               dac t1
               dio \overline{t}2 lac \overline{x}ys
              add sft
               dap .+1
              lac .
              dac .+6
              dac .+6
xor (10000
dac xyt
lac E1
                                           / change scr to scl or scl to scr.
              dio E2
              scr .
              scr.
              terminate
define
              integrate A,B
              cli
              lac i A
              scr 9s
              scr 1s
div t1
              hlt
              cma+cli-opr
              xct xyt
xct grv
dac B
              terminate
sft,
              lac .-1 scr 7s
              scr 6s
              scr 5s
              scr 4s
scr 3s
scr 2s
              scr 1s
              scr
              scl 1s
```

```
/sine-cosine subroutine Adams associates
/calling sequence= number in AC, jda sin or jdacos.
/argument is between +2 pi, with binary point to right of bit 3.
/answer has binary point to right of bit 0. Time = 2.35-? ms.
/changed for auto-multiply , ddp 1/19/63
cos,
            dap csx
            lac (62210
           add cos
           dac sin
            jmp . +4
sin,
           dap csx
           lac sin
           spa
si1,
           add (311040
           sub (62210
           sma
           jmp si2
           add (62210
si3,
           ral 2s
           mul (242763
           dac sin
           mul sin
           dac cos
           mul (756103 add (121312
           mul cos
           add (532511
           mul cos
           add (144417
           mul sin
           scl 3s
           dac cos
           xor sin
           sma
           jmp csx-1
           lac (377777
           lio sin
           spi
           cma
           jmp csx
           lac cos
csx,
           jmp .
si2,
           cma
           add (62210
           sma
           jmp si3
           add (62210
           spa
           jmp .+3
           sub (62210
           jmp si3
           sub (62210
```

jmp si1

```
/integer square root
/input in ac, binary point to right of bit 17, jda sqt/answer in ac with binary point between bits 3 and 9
/largest input number = 177777
sqt,
            dap sqx
            law i 23
            dac sq1
            dzm sq2
            lio sqt
            dzm sct
sq3,
            isp sq1
            jmp +3
            lac sq2
sqx,
            jmp .
            lac sq2
            sal 1s
            dac sq2
            lac sqt
rcl 2s
            sza i
            jmp sq3
            dac sct
            lac sq2
sal 1s
            add (1
            sub sqt
            sma+sza-skp
            jmp sq3
            spa
            cma
            dac sqt
            idx sq?
            ¿pa qm
sq1,
            0
sq2,
            0
```

```
/outline compiler
/ac=where to compile to, call _da oc
                                 /ot=address of outline table
define
           plinst A
           lac A
           dac i oc
           idx oc
           terminate
define
           comtab A, B
           plinst A
           jsp ocs
           lac B
           jmp oce
           terminate
           dap ocz
ocs,
                                /puts in swap
           dio i oc
           idx oc
           dio i oc
           idx oc
ocz,
           jmp .
           0
oc,
                                 /outline compiler proper
           dap ocx
           lac i ocx
           dap oce
plinst (stf 5
           dap ocm
           idx ocx
          plinst (lac sx1 plinst (lio sy1 clf 6
ock,
           setup occ,6
oci,
ocg,
           lio .
                                /outline table
och,
           cla
          rcl 3s
           dio oci
           lio (rcl 9s
          dispatch
           opr
           jmp oc1
           jmp oc2
000,
           jmp oc3
ocq,
           jmp oc4
ocp,
           jmp oc5
ocr,
           jmp oc6
```

```
/7 code
              plinst (szf 5
              add (4
              dap ocn
              plinst ocn
                        (dac sx1
              plinst
                        (dio sy1
              plinst
                        (jmp sq6
(clf 5
(lac scm
              plinst
              plinst
              plinst
              plinst
                        (cma
              plinst
                        (dac scm
                        (lac ssm
              plinst
                        (cma
              plinst
              plinst
                        (dac ssm
              plinst
                        (lac csm
                        (lio \overline{s}sd
              plinst
                        (dac ssd
              plinst
              plinst (dio csm
              plinst (lac ssc
                        (lio csn
              plinst
                        (dac csn
              plinst
              plinst (dio ssc
              plinst ocm
ocx,
              jmp .
ocm,
              jmp .
ocn,
              jmp .
              plinst (add ssn
oc1,
              jsp ocs
              lac (sub scn
              dac i oc
oce,
              idx oc
              sp ocs
              plinst (ioh
              lac (dpy-4000
ocd,
              dac i oc
              idx oc
              lio oci
              count occ, och
              idx ocg
              jmp ocj
oc2,
              comtab (add scm,
                                      (add ssm
oc3,
                       (add \overline{s}sc,
                                      (sub csm
              comtab
                       \begin{array}{c} \text{(sub } \overline{\text{scm}}, \text{ (sub } \overline{\text{ssm}} \\ \text{(add } \overline{\text{csn}}, \text{ (sub } \overline{\text{ssd}} \end{array})
oc4,
              comtab
oc5,
              comtab
осб,
              szf 6
             jmp oc9
stf 6
              plinst (dac ssa
              lac (dio \overline{s}si
              jmp ocd
              clf 6
009,
              plinst (lac ssa
              lac (lio \overline{s}si
              imp ocd
```

```
/display a star
define
            starp
            add bx
            swap
            add by
            swap
            ioh
            dpy-4000
            terminate
            dap blx
szs 60
                                     /star
blp,
            jmp blx
            random
            rar 9s
and (400700
            spa
            xor <u>(</u>377777 dac bx
            lac ran
            ral 4s
            and (400700
            spa
            xor (377777 dac by
            jsp bpt
            ioh
blx,
            jmp .
bpt,
            dap bpx
            random
            sar 9s
            sar 6s
            spa
            cma
            sal 3s
add (bds
dap bjm
            cla cli clf 6-opr-opr
            dpy-4000
bjm,
            jmp .
            repeat 10, starp
bds,
            szf 6
            jmp .
stf 6
bpx,
            cma
            swap
            cma
            swap
            jmp bjm
```

```
/background display - 3/13/62, prs.
             define
dislis J, Q
            dap fx+R
            clf 5
lac flo+R
            dap fpo+R
ſs,
            dap fin+R.
            dap fyn+R
            idx fyn+R
fin,
            lac
                        /lac X
                        /right margin
            sub fpr
            sma
            sub (20000
            add (2000
frr,
            spq
jmp fuu+R
fou,
            sub (1000
sal 8s
fie,
fyn,
            lio
                        /lio Y
            dpy-i
            stf 5
            idx fyn+R
fid,
            sad (lio Q+2
jmp flp+R
sad fpo+R
            jmp fx+R
            dap fin+R
            idx fyn+R
            jmp fin+R
fuu,
            szf 5
ſx,
            jmp
                        /return
            idx flo+R
            idx flo+R
sas (Q+2
jmp fid+R
            law J
dac flo+R
            jmp fid+R
            lac (lio J sad fpo+R
flp,
            jmp fx+R
            dap fin+R
            law J+1
            dap fyn+R
            jmp fin+R
fpo,
            lio
```

flo,

J

terminate

```
define
background
                  jsp bck
termin
                  dap bcx
szs 40
bck,
                  jmp bcx
                 jsp 1m
jsp 2m
idx bcc
                 and (1
                  sza
                 jsp 3m
law 3
bc1,
                 and bcc
                 sza i
                 jsp 4m
isp bkc
bc3,
                 jmp bcy
law i 10
dac bkc
law i 1
                 add fpr
spa
                 add (20000
dac fpr
jsp 1m
bcy,
bcx,
                 jmp
                 dislis 1j, 1q
dislis 2j, 2q
dislis 3j, 3q
dislis 4j, 4q
1m,
2m,
3m,
4m,
bcc,
                 0
bkc,
                 0
fpr,
                 10000
```

mul=mus div=dis

start

```
/main control routine for spaceships
nob=30
                        /total number of colliding objects
mlO,
        setup mtc, 5000
                                    /delay for loop
        init ml1, mtb /loc of calc routines
        add (nob
        dap mx1
                        / x
nx1=mtb nob
        add (nob
        dap my1
                        / y
ny1=nx1 nob
        add (nob
        dap ma1
                        / count for length of explosion or torp
na1=ny1 nob
        add (neb
        dap mb1
                       / count of instructions taken by calc routine
nb1=na1 nob
        add (nob dac mdx
                        ∕ đx
ndx=nb1 nob
        add (nob
        dac mdy
                        / dy
ndy=ndx nob
        add (nob
        dap mom
                       /angular velocity
nom=ndy nob
        add (2
        dao mth
                        / angle
nth=nom 2
        add (2
        dac mfu
                        /fuel
nfu=rth 2
        add (2
        dac mtr
                        / no torps remaining
ntr=nfu 2
        add (2
        dap mot
                       / outline of spaceship
not=rtr 2
        add (2
        dap mco
                       / old control word
nco=not 2
        add (2
        dac mh1
nh1=nco 2
        add (2 mh2
nh2=rH1 ?
        2) bbs
        dec min3
nh3= n'12 2
        add (S
        dae mh4
nh4=nh3 2
ทุกทายทุ้ง 2
```

```
law ssi.
         mor mtb
         572
         jmp adn
law ss2
         mor mtb 1
         sza
         jmp mdn
law 1
                    / test if both ships out of torps
         add ntr
         spa
         jmp md1
law 1
         add ntr 1
         spa 1
         jmp mdn
                    / restart delay is 2X torpedo life
         xet tlf
md1,
         sal <u>1</u>s
         dac ntd
         jap ml1
         count ntd, mla
mdn,
         stf 1
         stf 2
         law ss1
      . xor mtb
        sza
         clf 1
        sza i
        idx 1sc
        law ss2
        mor mtb 1
        sza
        clf 2
         sza i
         idx 2sc
         clf 2
         jon a
```

```
81,
                                / test word control
             law <u>mg</u>2
             dec ous
             វូមក្ ឧ
  a4C,
                          / here from start at 4
            law cwm
            dec CMC
             jແກ ຂຣ
  1so.
                          /scores
  2sc,
            0
ំ ខ,
            dzm 8j1
dzm 8j2
lac Sct
            sma
            jup a5_
count got, a5
            lac 1sc
sas 2sc
            inp a4
law i 1
dac Ent
 ٤5,
            lat
            and (No
            sza i
            jap a2
jap fi1
lat
  гЩ,
            and (40
            sza
            jmp s2
dzm 1sc
            dzm 2sc
            let
rar 6s
and (37
  aб,
            sza.
            ema
dao got
            clear ntb, nnr-1
 22,
                                                 / clear out all tables
            law ss1
            dae mtb
            law ss2
            dac mtb 1
            lee (20000c
            dae nx1
            dre ny 1
            ome
            dec nul 1
            dec ny1 1
lec (1/14/20
            cac nth
```

```
/ start of outline program
         law nrr
         dac not
         lio ddd
spi i
imp a3
jda oc
                          / compile outline
         ot1
         dac not 1
ε3,
         dap fil
         jda oc
         ot2
         dap fil2
         met tho
         dac ntr
dac ntr 1
         lac foo
         dec nfu
         dac nfu+1
         law 2000
         dac nb1
         dac nb1 1
        rct mhs
         dac nh2
         dac nh2 1
```

jmp mlo

```
/ control word get routines
mg1,
          dap mg3
          iot 11
          jsp 8a
811,
          0
          dac T1
          iot 111
          jsp 8a
8j2,
          0
          lio T1
          ril 4s
          rer 4s
mg3,
         jmp .
mg2,
        dap mg4
          lat
          swap
mg4,
          jap.
idl,
         idx mth
          idx mfu
          idx Mtr
          idn mee
          idx mot
          ldx mom
ldx mhl
idx mh2
          idx mh3
         idx mxi
idx myi
ids,
          idx mai
          idx mbi
          idx Edy
          idx mdx
                             / 1st control word / zero if not active
c11.
          lac .
          ezn i
          jop med
dap . 1
                             / not active
          jap.
         lac add ite dae ate
ر ئانات
                             / alter count of number of instructions
          ida mli
mq1,
          sed (lac abb 1
          inp dl
          sas (lac abb nob
          jup ids
          background
                           / display massive star
/ use up rost of time of main loop
/ rejeat whole works
          Jap blo
count libe, .
          jap mlC
```

```
Sa,
                                                                                                                                        ray Ser
dap Ser
dap Ser
                                                                                                                                          adm dam olf 7 spi 5 stf 5 stf 6 ril 1
                                                                                                                                              spi
jap Sec
 Se.y,
                                                                                                                                              120
                                                                                                                                        Sađ,
                                                                                                                                            rir Sa
                                                                                                                                            sp1
                                                                                                                                        spi
jap Saq
nir 50
spi
icr (14
nir 1s
spi
lor (1
                                                                                                                                                jup ĉea
Sao,
                                                                                                                                            cla
                                                                                                                                          rir 9s
                                                                                                                                            spi
                                                                                                                                            law ?
                                                                                                                                              jap Sad
Sag,
                                                                                                                                       TECHNOLOGICA CANONIA STANDONOS CONTROLOGICA CANONICA CANON
Sar,
Orm,
```

```
col,
          ್ಷಾ ೧೦೫
          18W 1
          add all sed (lee math mob
          jmp com-1
          dap ml2
          law 1
          add mx1
          dap mx2
          law 1
          add myl
          dap my2
          law 1
          add ma1
          dap ma2
          law 1
          add mbi
          dap mb2
                      / 2nd control word / can it collide? / no / cald if collision
m12,
          lac .
          spq
          jap mg2
lec .
mx1,
                            / delta n
/ take obs cal
mx2,
          sub.
          spa
          oma
          dac Et1
                           / < EPSILON ?
          sub mel
          STE
          jmo mg2
lac .
                           / no
my1,
my2,
          sub .
          spa.
          CHR
                           / < epsilon ?
          sub mel
          cma
         Jas ug2
add mtl
                            / no
         sub me2
         sçs
          jmp com
idm mm2
mg2,
                            / and of companison loop
         idx my2
          1dm na2
         idx mb2
          index ml2, (lee mtb nob, ml2
          idm com
         3: •
cox,
```

```
/routile to set employion
           15W 20
           dae i mb1
          dec i mb2
lac (cex 400000
sem,
                                                 /TYPLODE
          date i all / replace calc routine with evolution
          dae i ml2
                             / duration of explosion
mb2,
           . fbs
           cma
          sar 8s
add (1
ra1,
          ଟିଅପ ⋅
୍ଷ ଅଧି
          dac .
/ mise calculation routines
          / emplosion
          lac : Edx
mex,
          sar 3s
add i mx1
dac i mx1
lac i mdy
          sar 3s
add i my1
dac 1 my1
          law mst
          dap msh
          lec i mb1
                             / time involved
          cma cli-opr
sar <u>3</u>s
dae mxe
          sub (140
          sma.
          id: msh
mz1,
          lac ran
          and (777 for (scl
          dec mid
          randon
          ser 9s
sir 9s
xet.
msh,
~11,
          hlt
          add i myi
          swop
edd i mmi
dpy-1 300
count mac, mmi
          count i mai, mbi
dem i mli
jmp mbi
200
         som 1.s
          ser 3s
```

```
/ torpedo calc routine
ter,
          Jap col
          jmp sex-3
          count i ma1, te1
          lac (mex 400000
          dac i ml1
          law : 2
dac i mai
          law 20
          dac i mbi
          jmp mb1
tc1,
          lac i mail
          sar 9s
          met the
         add i mdy
dae i mdy
sar 3e
         add i my1
          dac i my1
         sar 9s
xct th<u>e</u>
         add i mdm
dac i mdm
         sar 3s
add i mx1
dac : mx1
         dispt 1, i my1, 1
          jmp mb1
/ hyperspace routines
/ this routine handles a non-colliding ship invisibly
/ in hyperspace
hp1,
          count i ma1, mb1
                            / next step
          law hp3
          dac i ml1
         law 7 dac i mb1
          random
         ser 9s
sir 9s
net hr1
          add i mx1
         dac i mui
          gswap
         edd i myi
dae i myi
dan i mdw
dam i mdy
          met hd2
          dec i me1
          imp mb1
```

-

/ this routine handles a ship breaking out of hyperspace.

```
jsp col
jmp sex
count i ma1,hp6
hp3,
           18M S000
           dac i mb1
lac i mh4
           add hur dac 1 mh4
           random
           ior (400000 add 1 mh4
           SDA
           imp po1
lac i mh1
           dac i ml1
           lac ran
           ser 9s
           sir 9s
           xet hr2
           dac i mdy dio i mdx
           setup hpt,3
           lac ran
           dac i mth lac i mth
hp4,
           sma
           sub (311010
           spa
           add (311.040
           dac i mth
          count hpt, hp4
count i mh2, hp7
dzm i mh2
hp7,
           net hd3
           dac i Th3
hp6,
           lac i mx1
           dispt 1, : my1, 2
           jmp mb1
```

```
/ spaceship calc
            isp i cwg
dio sew
 ss1,
            jmp sr0
 ss2,
            jsp i cwg
            rir 4s
            dio scw
 srO,
sc1,
            clf 5
            jsp col
            jmp sex
            lio Scw
            clf 6 cla-opr /update angle
            spi
           add maa
           ril 1s
           spi
           sub maa
mom,
           add .
           dac i mom
           szs 10
           jmp . 3
dzm i mom
           ral 7s
           ril 1s
           sp:
           stf 6
           lio i mfu
spi i
clf 6
mth,
           add .
           swa
           sub (311040
           spa
add (311040
dac 1 mth
           jda <u>s</u>in
          dec sn
dzm bx
dzm by
           szs 60
          jmp bsg
lac i mx1
dac t1
mul t1
           scr 1s dac acx
           cla
           ser 2s
          dio Tox
lac i my1
dac t1
          mul t1
scr 1s
dae acy
```

```
cla
         sor 2s
         swap
         add Tox
         swap
         scl<sup>2</sup>s
         add acx
         add acy
         sub str
         sma i sza-skp
         jmp pof
         add str
         varsft
         dac t1
         ide set mul t1
         undosft
         ser 9s
         scr 6s
         szs i 20
                           / switch 2 for light star
         scr 2s
         sza
         jmp bsg
         ser 1s
dio E1
         integrate mx1, bx
         integrate my1, by
bsg,
         lac i mth
         jda cos
         dac cs
         sar 9s
         met sac
         szf 16
         cla
         add by
         diff mdy, my1, (sar 3s lac sn
         sar 9s
         xct sac
         cma
         szf i 6
         cla
         add bx
         diff mdx, mx1, (sar 3s
         scale sn, 5s, ssn
scale cs, 5s, scn
lac 1 mx1
         sub ssn
         dac sx1
         sub ssn
         dac stm
```

```
lac <u>i</u> my1 add scn
         dac sy1
         add scn
         dac sty
scale sn, 9s, ssn
scale cs, 9s, scn
         dac sem
         lac ssn
         dac ssm
         add scn
         dac ssc
         dac ssd
         lac ssn
         sub scn
         dac csn
         cma
         dae csm
         cla cli-opr
         dpy-4000
mot,sp5,
                     jap i .
         ioh
sab,
         lio scw
         ril 2s
                          / not blasting
         spi i
                         / no tail
         jnp sq9
        ranct sar 9s, sar 4s, src scale sn, 8s, scn scale cs, 8s, scn
         count i mfu, st2
         dzm i mfu
         imp sc9
yiner sx1, sy1, sub
         dispt i, sy1
         count src, sq7
                                  / check if torp tube reloaded
         count 1 ma1, sr5
sq9,
                        / prevent count around
         dzm i ma1
                          / previous control word
         lac .
mco,
         ema
         szs : 30
         clc _
         and scw / present control word
         ral 3s
                    / torpedo bit to bit 0
         sma
         jmp sr5 / count i mtr, st1 dzm i mtr
                     / no launch
                                         / check if torpedos exhausted
                                         / prevent count around
         jmp sr5
init sr1, mtb nob-1
st1,
                                 /search for unused object
         lac .
sza i
smi,
                         / 0 if unused
         jup sr2
         law : 1
         add sri
         dan srl
         sas (lac mtb-1
         jmp sr1
hlt
                         / no space for new objects
         jap sr5
```

```
/ set up torpedo calc
         lac (tcr
sr2,
         dac i sr1
         law nob
         add sr1
         dap <u>s</u>s3
         dio . add (nob
ss3,
         dap ssl
         lio sty
ss4,
         dio .
         add (nob
         dap sr6
         add (nob
         dap sr7 add (nob
         dap sr3 add (nob
         dap srlllac sn
         met tul
         cma
         add i mdx
         dac :
sr3,
         xct tvl
         add i mdy
sr4,
         dac.
         met rlt
                      / permit torp tubes to cool
         dac i ma1
         xct tlf / life of torpedo
         dac . lac mtb nob-1
sr6,
         sub sr1
         sal 3s
         add (30
                          / length of torp calc.
sr7,
         dap .
         lac scw
sr5,
         dac i mco
         count i mh3, mb1 dzm i mh3 lac i mh2
         sza i
         jmp mb1
         lac scw
and (600000
xor (600000
         sza
         jmp mb1
lac i ml1
dac j mh1
         lac (hp1 400000
         dac i ml1
         net hd1
         dac 1 ma1
         lav 2
         dac i mb1
         jmp mb1
```

```
/ here to handle spaceships dragged into star
/ spaceship in star
         pof,
         szs 50
         inp po1
lac (377777
         dac i mx1
        dac i my1
lec i mb1
dac ssr
         count ssn, .
         imp mb1
po1,
        lac (mex 400000
                                      / now go bang
        dac i mll
        law ! 10
        dac i ma1
        jmp mb1
/ outlines of spaceships
ot1,
        111131
        11/111
        111111
        111163
        31111
        146111
        111114
        700000
. 5/
        013113
ot2,
        116313
        131111
        161151 111633
        3651-4
        700000
. 5/
        variables
        constants
.-64/
        . 100/
                       / space for patches
p,
```

```
/display score routire
```

```
/set size of spaceship
fss,
          0
          dap fs1
          lac <u>f</u>ss
dac <u>s</u>cm
          dac <u>s</u>sc
          dac ssd
          dac scn
          dac csm
          cma
          dac csn
          dzm ssn
          dzm ssm
fs1,
          jmp .
fil,
          law .
                       /set return of compiled outline
          sub c21
          dac to
fi2,
          law .
          sub c21
          dac t7
          lac c23
dac t4
fis,
          szf 3
          lio 2sc
szf i 3
lio 1sc
                       /get score
          scl 1s
          cla
          div c12
          hlt
          sza
          jmp fx1
dio t3
law 400
flor.
          jda fas
          law fys
          dap frt
flt
          idx t3
          cma
          dac t3
          law fus
          dap i t6 dap i t7
          lac c20
szf 3
fus,
          ama
          dac syl
          add c30
          dac t4
          dec sxi.
```

```
fds,
          szf 3
                      /display spaceship
          law not
         szf i 3
law not 1
dap fug
idx t5
ral 9s
         cl1
         dpy-4000+700
         isp t3
          jmp i .
fug,
frt,
         jmp .
         law 4000
fys,
         jda fss
         law fub
         dap i t6
         dap i t7
         lac c26
         dac sx1
         lac c20
         szf i 3
         cma
         add c30
         dac sy1
         law i 2
         dac t3
         jmp fds
         szf 3
fub,
         jmp . 3
stf 3
         jmp . 2
clf 3
         iot 11
         dio T1
         iot 111
         dio t2
         law 1
         and <del>T</del>1
         and t2
         sza
         jmp fik
         law 2
         and T1
         and t2
         sza i
         jmp fis
         law a4+1
         dap fiu
         jmp fwt
         law 4
fik,
         dap fiu
         add .
fwt,
         dac £1
         isp T1
         jmp .-1
fiu,
         jmp .
```

```
fx1,
           dio T1
           dac t3
law fx2
           dap frt
law 1100
jda fss
           jmp flt
lio t1
fx2,
           jmp fkr
c12,
           12
           200000
c20,
c21,
           21
           -200000-30000
-260000
30000
c23,
c30,
t3,
t4,
t5,
t6,
           0
           0
           0
                         / table of objects and their properties
mtb,
start 4
```

```
spacewar 4.2 5/11/63 ddp: pt 1 - pass 1 spacewar 4.2 5/16/63 ddp: pt 2 - pass 1 stars by pro for s/w 2b - pass 1 spacewar 4.2 5/11/63 ddp: pt 1 - pass 2 spacewar 4.2 5/16/63 ddp: pt 2 - pass 2 stars by pro for s/w 2b - pass 2 spacewar 4.2 syms 5/2363 jcm
```

Constants area, inclusive from to

2**714** 3042

ccccccccdffieknsuroptouorrt 1sbgsut 12nstv12313467tffffffffffffffffffffffffffffffffffff
311047 6 361 4 420 5 4 6 51653 6 32 77 342752 1112221242332213733354311511343333333333332322212222222222

ndunhall nnom not	7335713 7751577 6455566 34745157 63666566 3474517 63666666 3474157 63666666666664437266420005122350134465722232232231162222323333333333333332344442442442322232223223
sex	1001
ntr ntr ny1 occ 1234569cdeghijkmnoopqrsxz12 occ occ occ occ occ occ occ occ occ occ	177 14405064200512535013446572 1323444442442255654777666572

tillin 5123679tx1234567c01234acdimn12rxy11 sssssssssssssssssssssttttttttttttttt	614776073 61410732217344674672222222222222222222222222222222
---	---

v2 3 xys 2642 xyt 2645

```
spacewar 4.0 2/2/63 ddp : pt. 1
   3/
              jmp sbf
                                                   / ignore seq. break
              jmp a40
              jmp a1
                                           / use test word for control, not iot 11 co
   / interesting and often changed constants
   /symb loc
                   usual value (all instructions are executed,
              / and may be replaced by jda or jsp)
   tno, 6,
                     law i 41
                                          / number of torps + 1
   tvl, 7,
                     sar 4s
                                          / torpedo velocity
                                        / torpedo velocity
/ torpedo reload time
/ torpedo life
/ fuel supply
   rlt, 10,
                     law i 20
maa, 13, 10
sac, 14, sar 4s
str, 15, 100
me1, 16, 6000
me2, 17, 3000
ddd, 20, -0
the, 21, sar 9s
mhs, 22, law i 10
hd1, 23, law i 40
hd2, 24, law i 100
hd3, 25, law i 200
hr1, 26, scl 9s
hr2, 27, scl 4s
hur, 30, 7an, 31, 0
grv, 32.
  tlf, 11,
foo, 12,
                     law i 140
                                         / spaceship angular acceleration / spaceship acceleration / star capture radius
                                         / collision "radius"
                                          / above/2
                                         / 0 to save space for ddt
/ amount of torpedo space warpage
                                         / number of hyperspace shots
                                         / time in hyperspace before breakout
                                         / time in hyperspace breakout
/ time to recharge hyperfield generators
                                         / scale on hyperspatial displacement
                                          / scale on hyperspatially induced velocity
  hur, 30,
ran, 31,
grv, 32,
                                          / hyperspatial uncertancy / random number
                    sar 6s
                                          / gravitational constant
  / place to build a private control word routine.
  / it should leave the control word in the io as follows.
  / high order 4 bits, rotate ccw, rotate cw, (both mean hyperspace)
/ fire rocket. and fire tormedo Towardor " in the io as follows.
     fire rocket, and fire torpedo. Low order 4 bits, same for
         other ship. Routine is entered by jsp cwg.
  40/
 . 20/ / mg1
                                        / normally iot 11 control
```

```
/ routine to flush sequence breakes, if they occur.
sbf,
           tyi
           lio 2
           lac 0
           lsm
           jmp i 1
           define
xincr X,Y,INS
           \begin{array}{c} \texttt{lac} \ \underline{\texttt{Y}} \\ \texttt{INS} \ \overline{\texttt{ssn}} \end{array}
           dac Y
           lac X
           INS scn
           dac X
           term
           define
yincr X,Y,INS
           lac Y
           INS scn
           dac Y
           lac X
           -INS+add+sub ssn
           dac X
           terminate
           define
dispatch
          add (. 3 dap . 1
           jmp .
           term
           define
dispt A,Y,B
           repeat 6
                            B=B+B
           lio Y
           dpy-A+B
           term
           define
scale A,B,C
           lac A
           sar B
           dac C
           term
```

```
define
diff V,S,SF
add i V
dac i V
xct SF
add i S
dac i S
term

define
random
lac ran
rar 1s
xor (355670
add (355670
```

define
ranct S,SS,C
random
S
SS
sma
cma
dac C
terminate

dac ran term

```
define
           varsft
           dzm xys
           dac \frac{\overline{t}_1}{idx} \frac{\overline{x}ys}{idx} \frac{\overline{x}ys}{t_1}
v۶,
           scr 2s dac t1
           sza
           .jmp v2+R
           scr 2s
           swap
           terminate
define
           undosft
           dac t1
dio t2
lac xys
           add sft
           dap .+1
           lac .
dac .+6
           dac .+6
xor (10000 / change scr to scl or scl to scr.
dac xyt
lac t1
           dio T2
           scr .
           scr .
           terminate
define
           integrate A,B
           cli
           lac i A
           scr 9s
           scr 1s
div t1
           hlt
           cma+cli-opr
           xct xyt
           xct grv
           dac B
           terminate
sft,
           lac .-1
           scr 7s
           scr 6s
           scr 5s
           scr 4s
           scr 3s
           scr 2s
           scr 1s
           scr
           scl 1s
```

```
/sine-cosine subroutine Adams associates
/calling sequence= number in AC, jda sin or jdacos.
/argument is between +2 pi, with binary point to right of bit 3.
/answer has binary point to right of bit 0. Time = 2.35-? ms.
/changed for auto-multiply , ddp 1/19/63
cos,
          dap csx
          lac (62210
          add cos
          dac sin
          jmp .+4
          0
sin,
          dap csx
          lac sin
          spa
         add (311040
si1,
          sub (62210
          sma
          jmp si2
         add (62210
si3,
         ral 2s
         mul (242763
         dac sin
         mul sin
         dac cos
mul (756103
add (121312
         mul cos
         add (532511
         mul cos
         add (144417
         mul sin
         scl 3s
         dac cos
         xor sin
         sma
         jmp csx-1
         lac (377777
         lio sin
         spi
         cma
         jmp csx
         lac cos
csx,
         jmp .
si2,
         cma
         add (62210
         sma
         jmp si3
         add (62210
         spa
         jmp \cdot +3
         sub (62210
         jmp si3
         sub (62210
```

jmp si1

```
/integer square root
/input in ac, binary point to right of bit 17, jda sqt /answer in ac with binary point between bits 8 and 9
/largest input number = 177777
sqt,
          dap sqx
          law i 23
          dac sq1
          dzm sq2
          lio sqt
          dzm sqt
sq3,
          isp sq1
          jmp \cdot +3
          lac sq2
          jmp .
sqx,
          lac sq2
          sal 1s
          dac sq2
          lac sqt
          rcl 2s
          sza i
          jmp sq3
dac sqt
          lac sq2
          sal 1s
          add (1 sub sqt
          sma+sza-skp
          jmp sq3
          spa
          cma
          dac sqt
          idx sq2
          jmp sq3
sq1,
          0
sq2,
          0
```

```
/outline compiler
/ac=where to compile to, call jda oc
                              /ot=addres of outline table
define
         plinst A
         lac A
         dac i oc
         idx oc
         terminate
define
         comtab A, B
         plinst A
         jsp ocs
         lac B
         jmp oce
         terminate
         dap ocz
                              /puts in swap
ocs,
         dio i oc
         idx oc
         dio i oc
         idx oc
ocz,
         jmp .
                              /outline compiler proper
oc,
         dap ocx
         lac i ocx
         dap ocg
plinst (stf 5
         dap ocm
         idx ocx
         plinst (lac \overline{s}x1 plinst (lio \overline{s}y1
ock,
         clf 6
         setup occ,6
ocj,
ocg,
                              /outline table
         lio .
och,
         cla
         rcl 3s
         dio oci
         lio (rcl 9s
         dispatch
         opr
         jmp oc1
oco,
         jmp oc2
         jmp oc3
ocq,
         jmp oc4
ocp,
ocr,
         jmp oc5
         jmp oc6
```

```
plinst (szf 5 /7 code
               add (4
               dap ocn
              plinst ocn
              plinst (dac \overline{s}x1
                           (dio sy1
              plinst
                           (jmp sq6
              plinst
                           (clf 5 (lac scm
              plinst
              plinst
              plinst
                           (cma
              plinst
                           (dac scm
                          (lac ssm
              plinst
                           (cma
              plinst
              plinst
                           (dac ssm
              plinst
                           (lac csm
              plinst (lio \overline{s}sd plinst (dac \overline{s}sd
              plinst (dio csm
              plinst (lac \overline{\underline{s}}sc plinst (lio \overline{\underline{c}}sn plinst (dac \overline{\underline{c}}sn
              plinst (dio \overline{s}sc
              plinst ocm
ocx,
              jmp .
ocm,
              jmp .
ocn,
              jmp .
oc1,
              plinst (add ssn
              jsp ocs
              lac (sub scn
              dac i oc
oce,
              idx oc
              jsp ocs
              plinst (ioh
              lac (dpy-4000
ocd,
              dac i oc
              idx oc
              lio oci
              count occ, och
              idx ocg
              mp ocj
oc2,
              comtab (add \overline{s}cm, (add \overline{s}sm
             comtab (add \overline{\underline{s}}sc, (sub \overline{\underline{c}}sm comtab (sub \overline{\underline{s}}cm, (sub \overline{\underline{s}}sm comtab (add \overline{\underline{c}}sn, (sub \overline{\underline{s}}sd
oc3,
oc4,
oc5,
             szf 6
oc6,
             jmp oc9
stf 6
              plinst (dac ssa
lac (dio ssi
              jmp ocd
              clf 6
oc9,
              plinst (lac ssa
              lac (lio ssi
              jmp ocd
```

```
/display a star
define
          starp
          add bx
          swap
          add by
          swap
          ioh
          dpy-4000
          terminate
          dap blx
                                 /star
blp,
          szs 60
          jmp blx
          random
          rar 9s and (add 340
          spa
          xor (377777 dac bx
          lac ran
ral 4s
          and (add 340
          spa
          xor (377777 dac by
          jsp bpt
          ioh
blx,
          jmp .
bpt,
          dap bpx
          random
          sar 9s
sar 5s
          spa
          cma
          sal 3s
add (bds
          dap bjm
cla cli clf 6-opr-opr
          dpy-4000
bjm,
          jmp .
bds,
         repeat 20, starp
          szf 6
bpx,
          jmp .
          stf 6
          cma
          swap
          cma
          swap
          jmp bjm
```

```
/background display • 3/13/62, prs.
          define
dislis J, Q, B
         repeat 6, B=B+B
         clf 5 lac flo+R
         dap fpo+R
ſs,
         dap fin+R
         dap fyn+R
         idx fyn+R
fin,
         lac
                        /lac X
         sub fpr
                        /right margin
         sma
         jmp fgr+R
add (2000
frr,
         spq
fou,
         jmp fuu+R
         sub (1000
sal 8s
fie,
fyn,
                        /lio Y
         lio
         dpy-i+B
         stf 5
         idx fyn+R
fid,
         sad (lio Q+2 jmp flp+R
         sad fpo+R
         jmp fx+R
         dap fin+R
         idx fyn+R
         jmp fin+R
fgr,
         add (-20000+2000
         jmp frr+R
fuu,
         szf 5
fx,
         jmp flo+R+1 /return
         idx flo+R
         idx flo+R sas (Q+2
         jmp fid+R
         law J
         dac flo+R
         jmp fid+R
flp,
         lac (lio J
         sad fpo+R
         jmp fx+R
         dap fin+R
         law J+1
         dap fyn+R
         jmp fin+R
fpo,
         lio
flo,
         J
```

terminate

```
define
 background
               jsp bck
               termin
              dap bcx
szs 40
 bck,
              jmp bcx isp bcc
              jmp .
law i 2
dac bcc
 bcx,
              dislis 1j,1q,3
dislis 2j,2q,2
dislis 3j,3q,1
dislis 4j,4q,0
              isp bkc
jmp bcx
law i 20
dac bkc
              law i 1 add fpr
              spa
              add (20000
              dac fpr
              jmp bcx
bcc,
              0
bkc,
             0
             10000
fpr,
```

mul=mus div=dis

start

```
spacewar 4.0 ddp 2/2/63 pt.2
/main control routine for spaceships
nob=30
                            /total number of colliding objects
mlO,
        load \overline{m}tc, -4000
                            /delay for loop
        init ml1, mtb
                            /loc of calc routines
        add (nob
        dap mx1
                            / x
nx1=mtb nob
        add (nob
        dap my1
                            / У
ny1=nx1 nob
        add (nob
        dap ma1
                            / count for length of explosion or torp
na1=ny1 nob
        add (nob
        dap mb1
                            / count of instructions taken by calc routine
nb1=na1 nob
        add (nob
        dac mdx
                            / dx
ndx=nb1 nob
        add (nob
        dac mdy
                            / dy
ndy=ndx nob
        add (nob
        dap mom
                            /angular velocity
nom=ndy nob
        add (2
        dap mth
                            / angle
nth=nom 2
        add (2
        dac mfu
                            /fuel
nfu=nth 2
        add (2
        dac mtr
                           / no torps remaining
ntr=nfu 2
        add (2
        dap mot
                            / outline of spaceship
not=ntr 2
        add (2
        dap mco
                           / old control word
nco=not 2
        add (2
        dac mh1
nh1=nco 2
        add (2
        dac mh2
nh2=nh1 2
        add (2
        dac mh3
nh3=nh2 2
        add (2
        dac mh4
nh4=nh3 2
nnn=nh4 2
```

```
law ss1
          xor mtb
          sza
          jmp mdn
          law ss2
          xor mtb 1
          sza
          jmp mdn
                           / test if both ships out of torps
          law 1
          add ntr
          spa
          jmp md1
          law 1
          add ntr 1
          spa i
          jmp mdn
                           / restart delay is 2X torpedo life
md1,
          xct tlf
          sal <u>1</u>s
          dac ntd
          jmp ml1
          count ntd, ml1
mdn,
          stf 1
          stf 2
          law ss1
          xor mtb
          sza
          clf 1
          sza i
          idx 1sc
          law ss2
          xor mtb 1
          sza
          clf 2

    \text{sza } \underline{i} \\
    \text{idx } \overline{2} \text{sc}

          clf 2
          jmp a
```

```
a1,
                                               / test word control
              law mg2
              dac <del>Cwg</del>
              jmp a
a40,
                                    / here from start at 4
              law cwr
              dac cwg
              jmp a6
              lac gct
а,
              sma
              jmp a5
              count gct, a5
              lac <u>1</u>sc
sas <u>2</u>sc
              jmp a4
              \begin{array}{cccc} \text{law} & \underline{i} & 1 \\ \text{dac} & \overline{g} \text{ct} \end{array}
              lat
a5,
              and (40
              sza i

\begin{array}{c}
\text{jmp} & \underline{a2} \\
\text{lac} & \underline{1}\text{sc} \\
\text{lio} & \overline{2}\text{sc}
\end{array}

a4,
              hlt
              lat
              and (40
              sza
              jmp a2
dzm <u>1</u>sc
              dzm Zsc
a6,
              lat
              rar 6s
              and (37
              sza
              cma
              dac gct
              clear mtb, nnn-1 / clear out all tables
a2,
              law ss1
              dac mtb
              law ss2
              dac mtb 1
              lac (200000
              dac nx1
              dac ny1
              cma
              dac nx1 1
              dac ny1 1
              lac (144420
              dac nth
```

```
law nnn
                           / start of outline program
        dac not
        lio ddd
        spi i
        jmp a3
                          / compile outline
        jda oc
        ot1
a3,
        dac not 1
        jda oc
        ot2
        xct tno
        dac ntr
        dac ntr 1
        lac foo
        dac nfu
        dac nfu+1
        law 2000
        dac nb1
        dac nb1 1
        xct mhs
        dac nh2
        dac nh2 1
```

jmp mlO

```
/ control word get routines
         dap mg3
mg1,
          cli
          iot 11
mg3,
          jmp .
mg2,
         dap mg4
         lat
          swap
mg4,
          jmp .
ml1,
                                / 1st control word
         lac .
                                / zero if not active / not active
          sza i
          jmp mq1
         swap
         idx moc
          spi
          jmp mq4
         law 1
         add ml1
         dap ml2
         law 1
         add mx1
         dap mx2
         law 1
         add my1
         dap my2
         law 1
         add ma1
         dap ma2
         law 1
         add mb1
         dap mb2
mot,
         lac .
         dap sp5
                         / 2nd control word / can it collide?
m12,
         lac .
         spq
                               / no
         jmp mg2
                               / calc if collision / delta x / take abs val
mx1,
         lac .
mx2,
         sub .
         spa
         cma
         dac mt1
                               / < EPSILON ?
         sub me1
         sma
                               / no
         jmp mq2
my1,
         lac .
my2,
         sub .
         spa
         cma
         sub me1
                                / < epsilon ?
         sma
         jmp mq2
                                / no
         add mt1
         sub me?
         sma
```

```
jmp mq2
lac (mex 400000  / yes, EXPLODE
dac i ml1  / replace calc routine with explosion
         dac i ml2 | duration of explosion
mb2,
         add .
         cma
         sar 8s
add (1
ma1,
         dac .
         dac .
ma2,
                              / end of comparison loop
         idx mx2
mq2,
         idx my2
         idx ma2
         idx mb2
         index ml2, (lac mtb nob, ml2
```

```
mq4
        lac i ml1
                      / routine for calculating spaceship
        dap . 1
                            / or other object and displaying it
        jsp .
lac .
add mtc
mb1,
                            / alter count of number of instructions
        dac mtc
mq1,
        idx mx1
                            / end of comparison and display loop
        idx my1
        idx ma1
        idx mb1
        idx mdx
        idx mdy
        idx mom
        idx mth
        idx mas
        idx \overline{m}fu
idx \overline{m}tr
        idx mot
        idx mco
        idx mh1
        idx mh2
        idx mh3
        idx mh4
        sza i
                         / if active
        jmp mq3
        dap . 1
        jsp .
lac <u>i</u> mb1
        add mtc
        dac mtc
        background / display stars of the heavens
mq3,
        jsp blp
                       / display massive star
                           / use up rest of time of main loop / repeat whole works
        count mtc, .
        jmp mlO
```

```
/ misc calculation routines
         / explosion
mex,
         dap mxr
         lac i mdx
         sar 3s
add i mx1
         dac i mx1
         lac i mdy
         sar 3s
add i my1
         dac i my1
         law mst
         dap msh
         lac i mb1
                        / time involved
         cma cli-opr
         sar <u>3</u>s
         dac mxc
ms1,
         sub (140
         sma
         idx msh
mz1,
         random
         and (777 ior (scl
         dac mi1
         random
         scr 9s
         sir 9s
         xct .
msh,
mi1,
         hlt
         add i my1
         swap
         add i mx1
         dpy-i 300
         count mxc, mz1
         count i ma1, mxr
         dzm i ml1
mxr,
         jmp .
mst,
         scr 1s
         scr 3s
/ torpedo calc routine
tcr,
         dap trc
         count i ma1, tc1
         lac (mex 400000
         dac i ml1
         law i 2
         dac i ma1
         jmp trc
tc1,
         lac i mx1
         sar 9s
         xct the
         add 1 mdy
         dac i mdy
```

```
sar 3s
add i my1
dac i my1
sar 9s
xct the
add i mdx
dac i mdx
sar 3s
add i mx1
dac i mx1
dispt i, i my1, 1
trc, jmp.
```

```
/ hyperspace routines
/ this routine handles a non-colliding ship invisibly
/ in hyperspace
         dap hp2
hp1,
         count i ma1, hp2
         law hp3
                             / next step
         dac i ml1
         law 7
         dac i mb1
         random
         scr 9s
         sir 9s
         xct hr1
         add i mx1
         dac i mx1
         swap
         add i my1
         dac i my1
         random
         scr 9s
         sir 9s
         xct hr2
         dac i mdy
         dio i mdx
         setup hpt,3
         lac ran
         dac i mth
hp4,
         lac i mth
         sma
         sub (311040
         spa
        add (311040 dac i <u>m</u>th
         count hpt, hp4
        xct hd2
        dac i ma1
hp2,
         jmp .
/ this routine handles a ship breaking out of
/ hyperspace.
hp3,
        dap hp5
        count i ma1, hp6
        lac i mh1
        dac i ml1
        law 2000
        dac i mb1
        count i mh2, hp7
        dzm i mh2
```

```
hp7, xct hd3
dac i mh3
lac i mh4
add hur
dac i mh4
random
ior (400000
add i mh4
spa
jmp hp5
lac (mex 400000
dac i ml1
law i 10
dac i ma1
law 2000
dac i mb1
hp6, lac i mx1
dispt i, i my1, 2
hp5, jmp.
```

```
/ spaceship calc
          dap srt
                                   / first spaceship
ss1,
          jsp <u>i</u> cwg
          dio scw
          jmp sr0
ss2,
          dap srt
                                   / second spaceship
          jsp i cwg
          rir 4s
          dio scw
sro,
          lio scw
                                  /control word
sc1,
          clf 6 cla-opr /control word /update angle
          spi
          add maa
          ril 1s
          spi
          sub maa
          add .
mom,
          dac i mom
          szs 10
          jmp sr8
          dzm i mom
          ral 7s
sr8,
          ril 1s
          spi
          stf 6
          lio i mfu
          spi i
          clf 6
mth,
          add .
          sma
          sub (311040
          spa
          add (311040
          dac i mth
          jda <u>s</u>in
dac <u>s</u>n
          dzm bx
          dzm by
          szs 60
          jmp bsg
          lac i mx1
          dac \frac{\overline{t}}{\underline{t}}1
          mul T1
          scr <u>1</u>s
dac <u>a</u>cx
          cla
          scr 2s
dio iox
lac i my1
          dac E1
          mul <del>t</del>1
          \frac{1s}{acy}
```

```
cla
             scr 2s
             swap
             add Tox
             swap
             scl 2s
             add \overline{a}cx
             add acy
             sub str
             sma i sza-skp
             jmp pof
            add str
            varsft
            dac T1
            jda sqt
            mul T1
            undosft
            scr 9s
            scr 6s
            szs i 20
                                        / switch 2 for light star
            scr 2s
            sza
            jmp bsg
            scr 1s
dio t1
            integrate mx1, bx
            integrate my1, by
bsg,
            cla
            sad i mfu
            clf 6
            lac i mth
            jda cos
            dac cs
            sar 9s
            xct sac
szf i 6
            cla
            add by

\frac{5}{\text{diff}} \frac{5}{\text{mdy}}, \text{ my1, (sar 3s)}

            sar 9s
            xct sac
            cma
            szf i 6
            cla
           add bx
           diff \overline{m}dx, mx1, (sar 3s scale <math>\overline{s}n, 5s, \overline{s}sn scale \overline{c}s, 5s, \overline{s}cn
sp1,
sp2,
           lac i mx1
```

```
sub ssn
          dac \overline{s}x1
          sub ssn
          dac stx
          \begin{array}{c} \text{lac} \ \underline{i} \ \text{my1} \\ \text{add} \ \underline{s} \text{cn} \end{array}
          dac sy1
          add scn
          dac sty
          scale \overline{s}n, 9s, ssn
          scale cs, 9s, scn
          lac ssn
          dac ssm
          add scn
          dac ssc
          dac ssd
          lac ssn
          sub scn
          dac csn
          cma
          dac csm
          lac scn
          dac scm
          cla cli-opr
          dpy-4000
sp5,
          jmp .
sq6,
          ioh
          ranct sar 9s, sar 4s, src
          lio scw
         ril 2s
          spi i
                                 / not blasting
          jmp sq9
                                 / no tail
         scale \overline{s}n, \delta s, \overline{s}sn
sq7,
         scale cs, 8s, scn
         count i mfu, st2
         dzm i mfu
          jmp sq9
         yincr sx1, sy1, sub
st2,
          dispt i, sy1
          count src, sq7
         count i ma1, sr5 / check if torp tube reloaded
sq9,
         dzm i ma1 / prevent count around
mco,
         lac .
                                / previous contro word
         cma
         szs i 30
         clc
         and scw
                       / present control word
         ral 3s
                                / torpedo bit to bit 0
          jmp sr5
                                 / no launch
                                / check if torpedos exhausted
         count <u>i</u> mtr, st1 dzm i mtr
                                / prevent count around
          jmp sr5
st1,
         init sr1, mtb
                                / search for unused object
sr1,
         lac .
         sza i
                                 / 0 if unused
          jmp sr2
         index sr1, (lac mtb nob, sr1
         hlt
                                 / no space for new objects
          jmp . -1
```

```
sr2,
              lac (tcr
                                            / set up torpedo calc
              dac i sr1
              law nob
              add sr1
              dap ss3
              lio stx
              dio . add (nob
 ss3,
              dap \underline{s}s4 lio \underline{s}ty
 ss4,
              dio .
              add (nob
              dap sr6
add (nob
              dap sr7 add (nob
             dap sr3 add (nob
              dap <u>s</u>r4
              lac \overline{s}n
             xct tvl
              cma
             add i mdx
 sr3,
             dac .
             lac cs
             \begin{array}{c} \text{xct tv}\underline{1} \\ \text{add i } \overline{m} \text{dy} \end{array}
 sr4,
             dac .
             xct rlt
                                / permit torp tubes to cool
/ life of torpedo
              dac i ma1
 trf,
             xct tlf
 sr6,
             dac .
             law 20
 sr7,
                                           / length of torp calc.
/ hyperbutton active?
             dap .
 sr5,
             count i mh3, st3
             dzm i mh3
             lac i mh2
             sza i
              jmp st3
             lac scw
             cma
             ior i mco
and (600000
             sza
             jmp st3
             lac i ml1
             dac i mh1
lac (hp1 400000
dac i ml1
             xct hd1
             dac i ma1
             law 3 dac i mb1
st3,
             jmp 3 LACT MES
CAC BCW
DAC I MCO
set,
                         Jmp.
                   ٠٠>
```

```
/ outlines of spaceships
ot1,
         111131
         111111
         111111
         111163
         311111
         146111
         111114
         700000
• 5/
ot2,
         013113
         113111
         116313
         131111
         161151
111633
365114
700000
• 5/
         constants
         variables
         . 200/
                              / space for patches
p,
                              / table of objects and their properties
mtb,
```

```
spacewar game saver patch
mg1=1510
ran=31
/+ tw → punch
/- tw → read
40/
cwr,
          dap cwx
          lat
cw2,
          cks
          ril 1s
          spi+spa i-skp
          jmp cw1
          rrb
          rpa-i
cw3,
          rir 4s
cwx,
          jmp .
          ril 3s
cw1,
          spi+sma i-skp
          jmp cw2
          jsp mg1
ril 4s
          ppa-i
          jmp cw3
6000/
                                    /new starting address
          lat
go,
          sma
           jmp pu
          rpb
          dio ran
          rpa-i
          jmp 4
          \begin{array}{c} \text{law } \underline{i} \text{ 200} \\ \text{dac } \overline{p} c \end{array}
pu,
          cli
          ppa
          isp pc
           jmp .-2
          lio ran
                            ril 6s
          ppb
                            ril 6s
          ppb
          ppb-i
          jmp 4
variables
```

start go

ffgghhdd3123456712rx12aa12o1nmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmm	3775 317333450665227 317332222222222223311111213311 31755654521521 31755654521521 317556545211 317111111111111111111111111111111111
mq2	1612 1662 1661 1706 1730